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Emperor Rudolf II, in the Laboratory of His Alchemist at Prague

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FOIBLES AND FALLACIES OF SCIENCE

An Account of Celebrated Scientific Vagaries

By

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ILLUSTRATED

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TO

DORIS WEBSTER HERING

AND

HOLLIS WEBSTER HERING

WHOSE EFFORTS ARE HELPING TO ADVANCE THE KNOWLEDGE
OF SCIENCE AND LITERATURE

PREFACE

Wherever science touches the unknown or knowledge borders upon the imaginative and the obscure—from psychoanalysis to relativity—the aberrant is continually present, the crooked riding upon or getting in the way of that which is straight. New achievements open new opportunities for frauds or fallacies or for new variations of old ones. The spiritualist today feels as fully entitled to his mysterious "ectoplasm" as the biologist to his protoplasm or the physicist to his electrons; mediums now fortify their pretensions by photography as they could not do in the early days of spirit rapping and table tipping; occultism rings its changes through a series of crotchets and quavers in the lengthening gamut of science; eugenics, whether sound or unsound, has displaced phrenology and other schemes of analyzing character that are no longer so popular as they once were; and "Ouija" is only a last century rose by another name. It seemed for a while as if nothing short of special legislation could stem the flood of bogus relics brought on by the opening of the tomb of Tut-Ankh-Amen, and these give a new interest to the Cardiff Giant which, in its turn, was a crude example of such attempts at forgery as art galleries, collections, and museums are suffering from today. The rainmaker as well as "the schoolmaster is abroad" in the land, and we would like very much to know whether he will eventually command the clouds as the aviator has conquered the air. Legislative bills to prohibit the teaching of evolution are reminders of fulminations against scientific theories in the past, some of which we have here recounted, and are a legitimate sequel to them.

The really scientific spirit is ready at any time to set up new ideas or upset old ones, but it wants good evidence

upon which to proceed; it is the unscientific that stands upon dogma. It gives one a queer sensation to read now what seemed incoherent jargon when uttered by Keely (of "Keely Motor" notoriety), and to find what a startling parallel it makes alongside of the revelations of atomic energy by eminent physicists, as these expound modern theories of atomic structure and proclaim the boundless stores of energy awaiting release. Their language of sincere scholarship based upon facts that are only now coming to light is almost identical with that used by Keely to exploit a sham thirty years ago. So far as words go the real was anticipated by the false. Hardly less striking is the imaginary air-combat of English and German aviators recorded in 1751, which was to become an actuality nearly a hundred and seventy years later.

A long experience in the study and teaching of physical science has brought the author into contact with so much pseudoscience posing as genuine, that it seemed to him worth while to write out in some degree of completeness an account of several foibles amounting at times to obsession, in which a few specific instances might serve as types to illustrate whole classes of vagaries. Some are of ancient origin and practice but they still survive and, as they are recounted—scenes from the past set over against views of the present—they reveal a never-ending struggle against ignorance, credulity, and audacity.

The nature of this work and the reasons for it are further brought out in the Introduction. It is a limited view of an illimitable field. It would not have been possible to obtain the reproductions of prints and sample pages, or the extracts from old and rare books, but for the facilities of the great libraries, especially the New York Public Library, which have been most courteously extended to the author, and which are accorded with marvelous generosity to every student. In addition to the references in the body of the

text, the titles of some of the books consulted in the preparation of this work are appended to the chapters. Grateful acknowledgment is here made to *The Scientific Monthly* and the *Bulletin of the Aeronautical Society* in which a portion of this material has appeared, to the artists and publishers who have permitted various reproductions, and to others who have given valuable assistance in procuring data and illustrations.

D. W. H.

New York, N. Y.
December, 1923

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INTRODUCTION

Literature and philosophy which, with art (not the arts), have always possessed the temple of culture, now clasp hands with science, which hitherto has had access to these sacred courts only by a back door or at best a side entrance—engineering and the various industries. Without doubt science has "arrived," and finds a place frequently now on the front page of the daily newspapers. Recent years have opened the eyes of the world to a realization that at the bottom of the success of these industries rests pure science—science intrinsically intellectual, and oblivious of all such things as the arts or trades; but the science must be a reality, not a sham. If this were the whole story it might be thought a waste of time to dwell upon the topics considered here; but marching along with truth is error—its shadow and inseparable companion—always keeping step with it, sometimes by its side, sometimes stretching out behind, sometimes even striding before; and this shadow is not infrequently mistaken for the reality, and sometimes proves the more attractive of the two. No sooner does a new fact or a new discovery appear in science than it is exploited in fakes. Many capable students of real science do not realize the extent to which pseudo-science is propagated today, and the hold it has upon popular attention at the very time that investigators are applying their efforts to realities or to the development of ideas that are founded upon real facts. That is not a new situation; it has often been so in the past, but it may be worth while to point out that it still is so.

Though dealing with subjects that are scientifically off color or even *outré,* this work is meant to be a serious study, and to present these subjects not only as they appeared

when they were new, but also to show the color they take on in the light of present day science, revealing at times an unexpected even startling resemblance between modern ideas and some that were thought hopelessly antiquated. The author has endeavored so to portray them as to make the story entertaining to a layman in science, and yet he has drawn upon original sources to an extent that should make the narrative of value to professional students who may refer to it for checking up data, and may rely upon it with whatever confidence these sources are entitled to receive.

It is not imagined that a sketch of a dozen pages is as good as an able treatise, but the brief descriptions and narratives here presented have been prepared from early and in many cases original sources, in the hope that they may be of use as well as of interest to readers who may have neither the time nor the opportunity to hunt up authorities.

The *facsimiles* and reproductions should be of interest and service; at least they make the subjects they illustrate more vivid. Everybody hears about Poor Richard and his Almanack, but few have the opportunity to see a copy of this celebrated publication.

Multitudes of people—thoughtful but making no pretension to scientific learning—have had their attention directed of late to Einstein's theory of relativity and especially its relation to gravity, and have been impressed by distorted and misleading statements regarding it; how many of them have any knowledge of the war that was waged for a century against Newton's theory of gravitation, or know about LeSage's great work to account for gravity?

It has not been the purpose to enter into the broad field of myth and legend which has been so well covered by Sir Walter Scott, Andrew Lang, Baring-Gould and others, but only to treat of such of them as appear in the name of science, real or fallacious. Concerning the search for

El Dorado, for example, while this famous quest was not undertaken avowedly with any scientific end in view, it contributed much to the spirit of geographic exploration in the sixteenth century, and to the development of geographic and ethnographic science. Though not essentially a scientific subject it was linked with geographic science as really as the search for the northwest passage, or for the north pole, or any undertaking organized specifically for the solution of a geographic problem. This foible, like many another, illustrated the completeness with which large numbers of people, even nations, may become obsessed by an hallucination.

It may be asked "Why give so much attention to subjects so antiquated as astrology or perpetual motion—subjects long ago abandoned or at any rate now passé?" The question would be more pertinent if either of these or any other of the general topics here considered were actually obsolete or even obsolescent. The excuse for including them lies in the force with which these things once seized and commanded general interest, and in the fact that with very many supposedly intelligent people similar things are little less compelling today than they were in the Dark Ages.

The state of science as well as of industry is still too disordered to gauge properly the effects which the war has produced upon them; the entire front of the forces engaged in scientific progress was altered; the work of our universities has been changed in its orientation; but if the effect in other countries can be judged by manifestations in Great Britain and the United States, professional and lay scholars, and not less the general public, are turning with more readiness and sympathy than ever to the mysterious and the occult, with a corresponding increase of mystic "profiteers."

Can an intelligent audience today feel complimented to

be called on to listen to a distinguished *litterateur* like Maurice Maeterlinck gravely explaining the ridiculous performances of the Ouija board (a revival of Planchette, which was consigned to the limbo of humbugs fifty years ago), by a theory of a super-material agency, "odic effluvia," going over almost precisely the ground traversed by the Abbé of Vallemont in 1696 as described in these pages in the section on Divination? The serious view taken of it by many of his auditors, by not a few editors, and possibly by the poet himself, must surely be due to ignorance of similar exploits in the past, or if not ignorance then something deserving a harsher name. Serious consideration of such things seems to arise from a failure to discriminate between actual and would-be science. But to claim a scientific attitude is thought to give a title to attention and consideration. It is the best claim to attention today that fakers can urge, and a credulous public likes to think itself scientific and is easily flattered into believing itself so.

Especially apropos is the quotation at the end of the section on The Divining Rod; written two hundred years ago, it might have been uttered yesterday. We are apt to think of the Middle Ages as preëminently a period of superstition, but one who has not made a study of the subject may well be astonished at the literature that has been written especially in the last quarter of a century; the societies that have been organized to propagate pseudo-science and pseudo-philosophy, whose activities are not diminished at the present time; the -isms, the -ologies and the -osophies; all parading in the guise or disguise of real science.

If astrology were part and parcel of an era in history like the age of chivalry, or of a social condition that has passed as the feudal system, it might be summed up in a few words and dropped, but it has not been devitalized; and moreover it is the most prominent scheme of divination

that is professedly scientific. Nearly all others run to dreams, or trances, or spiritualism in some form or other—a sort of hyper-science—even the prosaic divining rod being accused of hypnotizing.

Astrology as a cult flourished especially in the sixteenth and seventeenth centuries; towards the close of the eighteenth century it was rapidly losing its hold upon Europeans and Americans and had degenerated into mere brazen fortune-telling. It was at this low ebb for nearly a hundred years and yet, in the latter part of the nineteenth and the early part of the twentieth century, it revived! Its recrudesence in the face of the great advances in scientific knowledge and achievement seems an astonishing phenomenon that cannot be fully explained until we discover why even the learned have a craving after the occult. Its advocates, like all who attempt to peer into the mysteries of occultism, fall back upon that overworked formula

> "There are more things in heaven and earth, Horatio,
> Than are dreamt of in your philosophy."

At the present time numerous current periodicals devoted largely or wholly to astrology are published, not only in the Orient, to which we are in the habit of looking for things inclining to mysticism, but in the western countries also—four, at least, in America.

It may indeed be true that the revival of once flourishing subjects such as astrology is an outcome of larger knowledge, yet it may not be an indication of greater wisdom. The strides of science in the last half century have brought nations and races that were strange to one another into more intimate relationship and acquaintanceship; the closer bonds of communication and commerce have stimulated unrest and a tendency towards removal of inequalities of ownership and opportunity; and the cataclysm of a four years' world war with its violent overturning of dynasties,

and its political and social revolutions, must have wrought an upheaval of all agencies of disquiet and disturbance. It would indeed be strange, then, if wild notions concerning spiritual as well as material affairs did not share in the chaos preceding a readjustment of values, and it would be contrary to all experience of similar conditions in the past if we could suddenly acquire a sober and just view. The world's restoration to sanity must doubtless be gradual, and until the frenzy of unreason has subsided we cannot expect to be free from chimerical projects and schemes, *ignes fatui* ever luring the traveler along false trails that lead into a wilderness or come to a dead end.

In the chase after these phantoms the hunters are so very solemn about it all that a laugh is a mortal offence. Keyed up to the highest pitch of hope and anxiety, apparently they are so deeply absorbed in their pursuit that they are not conscious of the humor that often marks the situation. They take the step from the sublime to the ridiculous as complacently as a marionette, and it seems as if it can be nothing but their earnestness that prevents them from seeing how funny they sometimes are. A century after Martin Luther had hurled his inkstand at the Devil in the Wartburg (an incident not altogether lacking in humor), a more amiable encounter occurred in the City of Prague. There, about the year 1600, to the emperor Rudolph II, seated in a carefully prepared chair with lights burning low and amid weird sounds, comes in person this same Devil himself to dicker with the Emperor over supernatural help in his scientific undertakings—and three hundred years later, at a seance with a circle of mystics in the city of Brooklyn, a prominent divine and publisher receives astonishing revelations concerning the " widow's mite," along with other communications from the spirit world—upper or lower, who knows?

Alchemy, like astrology, was associated with black art

and was therefore anathema to the Church, but the evidence of the Devil's part in the mysterious processes was flimsy, though perhaps as good as that which sufficed in later days for the burning of witches. An ecclesiastical critic, ignorant of chemistry, visiting the laboratory of an alchemist, when sulphur was a common substance in chemical operations, was sharply on the lookout for any signs of a satanic presence:

"And did you find the arch fiend?" inquired a friend.

"I think so," was the reply, "I think so,—that is, I didn't see the cloven hoof but there was no mistaking the odor of brimstone!"

The story of some noted vagaries is painful, even tragic; others are simply amusing to an onlooker while, in their champions, the sense of humor is sleeping so profoundly that it is not awakened by a *contretemps* like the incident of Dr. Hamilton and the craniologist (related on page 155).

The author has endeavored to keep in view the mental attitude both of the actor, whether honest or dishonest, and of the populace. Hare-brained theorists are no less common in science than in politics, and are sometimes hardly less mischievous. The subjects become of especial interest when they affect people in large numbers. A propagandist of a new or revolutionary doctrine of science is sometimes a fanatic. Science has not yet found a cure for fanaticism; it disappears only as it burns out. Mass psychology is impressive, even on a limited scale, and sometimes it passes like a wave over whole nations—phrenology is an example. "Herd impulses," as ex-president Eliot of Harvard calls such manifestations, is perhaps a more suitable term.

Large space is given to Redheffer, Keely, Mother Shipton, and other single examples of fraud or fallacy because in them all, the peculiar mental traits of the public, exhibited as mass psychology, are conspicuous. Attention is focused

mainly upon English and American subjects, but a good deal of the narrative part has been derived from French and German records, and some from Dutch and Spanish.

How to account for the "crank," and what to do with him, are questions that concern the general public as well as the specialist. Restrain him? He is irrepressible. Ignore him? That may be unwise for often he is half right, sometimes wholly so. He is always disturbing, and though always abnormal he is not always unworthy, and the genus is of such infinite variety that it can never grow stale. No, the crank cannot be ignored because he is always the embodiment of notions that influence others, sometimes in large numbers; he is a type. Much depends upon the point of view. Columbus was a wise and learned man to his simple minded sailors; to companions of like temper with himself he was a daring adventurer and a hero; to the incredulous savants he was a crank.

A normal man is one whose mental, moral and physical qualities put him in what is called "normal" relation to the age and conditions of society in which he lives; he is in harmony with his environment and lives among his fellows without discord or friction.

One who continues to shape his conduct after the pattern of his predecessors, while failing to regard the advances that have been made; who will not ride in automobiles or tolerate jazz music; who declares that what was good enough for his ancestors is good enough for him, is "behind the times"; while he who is dissatisfied with prevailing views and customs, and chafes under the restraints which they impose upon him and consequently endeavors to better them, is either a crank or is "in advance of the age." If the latter is the case only the future can prove it; sometimes it does so—it may be soon, it may be centuries later. Just how far or in

how many respects an individual may depart from the normal without being generally regarded as erratic, is indeterminate, but there are few persons who have not some crotchets, and such persons we consider uninteresting and expect no especial achievement from them. It is only to the abnormal that we can look for any disturbance of an established order, whether for good or ill. Of these, some are a little out of line (but only a little) on many subjects; others are out of line on one subject only, but very much out; they may be very right in general, and yet on some one topic their aberration may amount to mania. The crankiness that crops out in various fields of endeavor often exhibits surprising acumen, shrewdness, and insight, coupled with defects of reasoning no less remarkable. All this is trite, of course, to the alienist. Sometimes the purely psychological aberration affects chiefly the actor himself, as in "New Thought" and such systems; and sometimes, when the performer is dishonest, it is meant to affect his victims, as in the Keely Motor and devices of that nature.

It is exhilarating to read the propaganda of strange cults among the announcements of Sunday services in the Saturday afternoon or Sunday morning newspapers of any large city. Employing various tricks of phraseology, especially alliteration, they fall readily in step with Mother Goose's rhymes or suggest the Mark Twain jingle:

> Punch, brothers, punch with care;
> League for the larger life.

Many of these "movements" are poorly disguised schemes for wheedling money from faddists—the old trick of "stealing the livery of the court of heaven to serve the devil in." While it is true that some projects once thought chimerical have been realized, and have thus justified their protagonists—at first villified as crack-brained, and then glorified as geniuses—the utterly fantastic character of other schemes

shows an unquestionable wryness in the persons at work upon them. Why they so frequently and continually recur is a mystery.

It is hard to tell which exhibits the greatest departure from the normal; the eager chaser after the will-o'-the-wisp, who is so wholly possessed by his idea that it becomes an obsession (that condition is abnormal even if he is sincere); the unscrupulous rogue who, by his plausibility, swindles his victims; or the admirers and victims themselves who, astute enough in general, are peculiarly susceptible to some particular form of deception, say scientific or religious, and who, along that line, are abnormally credulous and easily deceived —even in some instances pleased at being humbugged. The scientific mind is necessarily an open mind, and the over-credulous imagine themselves especially scientific in their readiness to accept evidences of strange new truths. But they do not always properly weigh the evidence. An array of testimony in the guise of facts, and of consequences that are unmistakable is often convincing before the evidence is known to be genuine, with no certainty that it means what they suppose, and least of all with any assured connection between the supposed cause and effect; and although "one swallow does not make a summer" a single fact is sometimes used to brace up a host of irresponsible and unfounded statements. In this way an American weather prophet has produced a system of forecasting which attributes large influence to the planet Vulcan while, so far as is yet established, there is no Vulcan; then a casual fulfilment of a prediction is taken as evidence that the theory is correct and a proof that Vulcan is a fact.

It is not the sincere worker whose efforts are based upon sound doctrine and real facts, and who works on in the face of discouragement, that we are considering, but the aberrant. Whatever may be his contention, his favorite method of establishing it is to challenge everything and everybody to

refute it. If he is dishonest he wants notoriety and this will procure it for him, whether the challenge is accepted or ignored; if he is honest he is so far deluded that if his challenge is not accepted he is convinced that it is unanswerable, and if he is controverted he feels that, like Galileo and a noble army of predecessors, he is a martyr to the conservatism of the age which resents enlightenment. It is not always possible to take these disputants seriously, no matter how seriously they take themselves, neither is it always safe to dismiss their ideas as ridiculous, for many a wise man has been ridiculed and contemned by others less wise than himself; and we need not look upon a quotation from the Alice books as a sign of feeblemindedness.

In speaking of the Keely motor, an English engineer and critic makes a generalization upon the psychology of Americans that is pretty broad yet perhaps not without justification. He says:

> It is a peculiar psychological fact that among a people so energetic and hard headed as the Americans every imposture, depending for its success upon mystery, should find multitudes of believers. America is the home of Mormon, Christian Scientist, and a host of other sects, who each follow the leadership of a single person, it may be ignorant and impudent, or it may be of that much learning that maketh mad, but at least all agreeing in being mystics of the very first water. . . . American geese are always swans, and really Keely deserves a good deal of attention. (Henry Riddell, M. E., on "The Search for Perpetual Motion," in the Report and Proceedings of the Belfast Natural History and Philosophical Society, 1915–1916.)

Instead of indicating superstition, however, does not susceptibility to the unknown or the mysterious belong rather to the *unmatured* stage of a people, or such part of them as are not restrained by the conventions of those from whom they have become detached? To a people who, in some sense, are still pioneers, before they have grown stale, and while they retain a freshness of imagination to which they are not unwilling to give a loose rein; a condition which made Ameri-

cans exuberant and bombastic, and gained for them a reputation that will require a long time to live down. That would account for the free play of fantastic ideas among Australians as well as among Americans—ideas which usually find fertile soil in newly settled and rapidly developing countries.

Libraries serve as reservoirs into which erratic papers and pamphlets flow in streams. A typical collection of sixteen quasi-scientific pamphlets, bound together under the general title "Paradoxes," in the New York Public Library, illustrates the lengths to which such aberration may go. Several of the papers are notable, and one or two are notorious. Merely to scan the titles is enough to make one dizzy; they are not all old, some might be called recent. Two or three will serve for illustration.

No. 3 is entitled:

The Invisible Made Visible—What the Planets Are Composed Of—What Effect They Have On Human Beings—What Effect They Have On Each Other—By Joseph Claburn—1893—Lexington, Ky.

As a specimen of astronomy this is amazingly, incredibly foolish.

No. 4 is:

Six General Laws of Nature—(A New Idealism)—A COMPENDIUM—of—A Large Work Divinity and The Cosmos—Containing—The Positive Cause of Force and Matter, An Explanation On All The Physical Phenomena in the Actuality of The Universe, and an Attack on the Modern Scientists and Philosophers.—Solomon J. Silberstein—New York—1894.

To judge from the weightiness of this "Compendium" the "Large Work" would be crushing. Mr. Silberstein also has another on *The Existence of the Universe—The Causation of Its Origin, etc.,* which sets one wondering.

The papers are most varied and fantastic; one is a rhapsody of Man, God, Geography, Electricity, Sun, Moon, and Tides, and contains the announcement of "an extensive work entitled 'A New Bible' to explain in detail the scientific

principles in the above topics!" In another the Rev. John Jasper is revived and the earth is proved to be a "stationary plane circle"; the Newtonian theory of gravitation is severely manhandled by several of the writers; and cosmic theories are proposed by some and overthrown by others; one especially affects odd words, and another article is made up wholly of epigrams and ejaculations of two or three words each.

An attendant in an asylum for the insane, speaking of the idiosyncrasies of the patients, said that the form their hallucination would take "depended altogether on *the temperature of their minds.*" (He was himself apparently somewhat mixed on temper, temperature, and temperament.) Some of the writers of these papers rival the projector in the Grand Academy of Lagado, spending his labors on a project to extract sunbeams from cucumbers.

During the Middle Ages superstition was rife in science, and vagaries abounded; in the eighteenth century a great clarifying was in progress, and by the beginning of the nineteenth extreme ideas of science were thought to have reached their acme of extravagance in seven different forms corresponding, perhaps, to the seven wonders of the world, and called the "Seven Follies of Science."

The late John Phin, in a work bearing that title, distinguishes properly between fraud and honest effort to discover and utilize the secrets of nature. In so discriminating he, with others, rejects astrology and magic because they are frauds, and gives as the generally accepted list of "Follies":

1. The quadrature of the circle; or, as it is called familiarly, squaring the circle.
2. The duplication of the cube.
3. The trisection of an angle.
4. Perpetual motion.
5. The transmutation of the metals.
6. The fixation of mercury.
7. The elixir of life.

I. D'Israeli, in "Curiosities of Literature," enumerates the "Six Follies of Science," omitting Nos. 3, 5, 6, and 7 of the above list, and including:

4. The Philosophical (or Philosopher's) Stone.
5. Magic.
6. Judicial Astrology.

Nos. 1, 2, and 3 above are purely mathematical and do not belong in a list that is limited to the physical sciences. The others are things to be achieved or produced by experimental processes or search and in that class come also

8. The Universal Solvent; and 9, The Fountain of Youth. This, indeed, is only a variant of No. 7, but it has been hardly less alluring than the others. Every one of these, at some time or other, has been undertaken in all seriousness.

In their relation to the existing state of knowledge they have all stood, in their day, as rational topics of inquiry, and therefore as legitimate questions to which a conclusive answer might be expected. For this reason they ought not to be called follies, for even if they may now be regarded as such it was not always so, and with as good reason we might regard as folly almost any novelty in the development of science. So we call them fallacies or foibles when we are not dealing with outright fraud; in that case we have "perversion" of science. In most instances the great difficulty has been to determine the line between honesty and deceit.

It will be seen that in the above lists, some of the subjects that have been dismissed as chimerical have been capable of reaching a phase such as science now approves, and various chimeras, once laughed out of court, have returned to make good their claim to acceptance and to serve us. As notable examples that have been realized we have aviation, self propelled vehicles, and apparently the transmutation of metals. Geographical vagaries have sometimes been of wide scope and long sustained interest as, for example, the myth of

Atlantis, the Northwest Passage, the Fountain of Youth, El Dorado, Symmes' Theory of Concentric Spheres, and still others. In 1492 the spherical form of the earth was a foible of Columbus.

The public is apt to look with suspicion at the announcement of any startling achievement for which it has not been prepared by gradual approach. Today the X-rays are commonplace, yet not only laymen but professional physicists were skeptical of them when the first announcements of them were received in this country. A final solution of the great problems of physics and chemistry, such as gravity, heat, electricity, radiation, etc., involves the ultimate nature of matter—itself the greatest problem of them all—and while the search for its solution continues vagaries will certainly come and perhaps go. No innovation that appears to be subversive of established ideas can acquire a standing without overcoming opposition in various forms, and one of the earliest and most effective forms that it has to encounter is ridicule or satire. But it has happened more than once that the chief fault with the innovation was that it was premature; and while in such case it needs great vitality to survive the ridicule with which it is met, if it is really true it is likely to reappear after an eclipse. Does it necessarily follow, however, that if it reappears it is really true? That has occurred with some systems of divining that have been scouted by orthodox scientists. Nevertheless, doctrines that have stood as sound science in their day, reached maturity and flourished, which died and were buried, may be on the eve of resurrection. Some of them, if they were now being promulgated for the first time, would be either ignored or laughed at in the light of modern knowledge which would show their fallacy. Again, apparently defunct notions have been resuscitated and revamped and brought into harmony with present-day knowledge and practice, have been shorn of excrescences that demormed them and stripped of dress that disfigured them;

and in consequence, doctrines that had been rather fantastic have received a real scientific character, and truths that had fallen into disrepute may have been rescued. This seems to be the case with physiognomy. Some vagaries are veritable Banquo's ghosts and will not down. Insuppressible and irrepressible, with these revival takes the place of survival and they return again and again to plague one or else to establish finally an indisputable right to live. Reversing the usual order, the follies of one generation have sometimes become the wisdom of the next. But it is not easy to escape contamination with bad associates, and upon any recurrence of old vagaries, even if they come bearing the promise of reform, they are apt to be put in the same class with new ones. Of these we have a superabundance in the shape of New Thought, Faith Healing, The Power of Will, etc., crowding the advertising columns of newspapers and magazines. What with short cuts to success, and marvelous methods of increasing one's power in all lines of endeavor, along with the ability to read character at sight, it would seem as if there were no excuse for anybody with moderate ability to stop short of the topmost rung in the ladder of Fortune or indeed to rest with only moderate ability. The situation is hit off well in an editorial of a current periodical:

> Life as it is lived by the rest of us must seem like loafing to those who have had their memories trained so that they can get the telephone book by heart in an evening, who have studied the science of physiognomy until they can place a passing stranger at a glance, and who have mastered the secrets of will power to such an extent that it is folly to dispute their purposes. Existence must appear a strangely pallid affair to you when there is no occasion to which you are not equal and when you have reduced the problems of every day to a series of logarithms, and locked them fast in an unshakable memory. (*The Globe and Commercial Advertiser,* New York, Nov. 12, 1919.)

While some of the old "Follies" persist, the progress of science has brought new ones to the fore and has focused at-

tention upon wonders of a kind that did not—could not—enter the minds of the ancients. Whether the elixir of life, the fountain of youth or the universal solvent has passed out of question or not, perpetual motion still engages the attention of inventors. The fact is, the thing that has become known and established has ceased to inspire the researcher. He is ready to pass that on to the utilizer, while his fancy revels in chimeras. A world consisting entirely of known facts would be as fatal to imagination as an arid world to vegetation.

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Frontispiece to *The True Prophecies of Michael Nostradamus. London, 1672.*

ASTROLOGY

The common belief that the so-called Follies of Science were long ago abandoned is not well founded. Astrology, Alchemy, and the Perpetual Motion are popularly dismissed as quite hopeless, but this is an error—not that the old expectations will ever be fulfilled—but the efforts to attain their fulfillment have by no means ceased. One or two of the early "follies" have been accomplished in a modified sense, others partially so, and still others have taken on new forms and reappeared in a new guise. Astrology, for example, is no longer one aspect of the science of Astronomy, but is altogether a scheme of divination, and as such is sometimes specifically called "judicial" astrology, and comes in the same class with palmistry and physiognomy. The "follies" do not die. They subside at times so far as to disappear from view, but they are like streams that flow awhile in open view, then reach a porous soil or sink into underground channels, and later emerge undiminished in volume and persistency.

Astrologers have always claimed for their practice the status of a science, but while such claim did not disturb real scientists, teachers of religion looked upon the pretensions and doctrines of astrologers as heretical and even blasphemous. In 1651 the Bishop of Chichester issued a sharp pamphlet to prove that "the original inventor of Astrology was the Devill," * and citing various learned authorities, including His Majesty King James I, in support of his argument.

The beginning of astrology probably coincided with that of astronomy, and doubtless the two subjects were developed

*ΑΣΤΡΟΛΟΓΟΜΑΝΙΑ, *The Madnesse of Astrologers,* by George Carleton, Bishop of Chichester, London, 1651.

together for many years. With the imperfect means available to conduct observations science, at first, could not be very exact as we now think of exactness in science, and much of the supposed knowledge about the heavenly bodies was guess work. To a considerable extent it was evolved from within the scholar and was philosophy rather than science. However, fairly accurate information was early acquired concerning the apparent motion of the planets of the solar system, and the general configuration of the constellations, with the position of the particular stars in them.

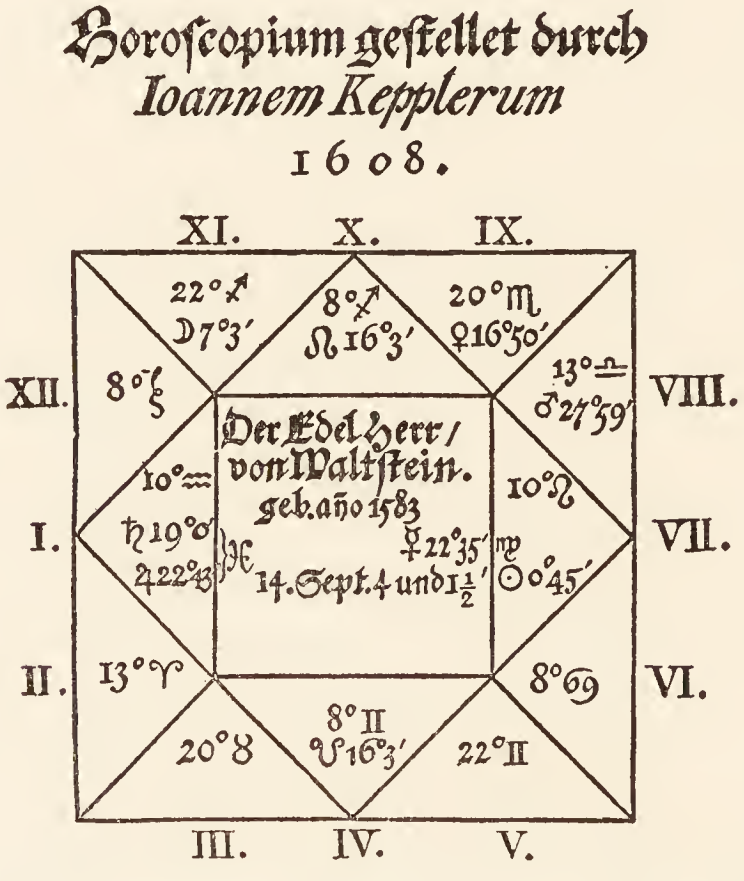
The early philosophers were idealists and it was quite in keeping with their bent of mind to associate the stars with human affairs. The effect of the sun in tempering the conconditions of life on the earth was obvious, and it required no great stretch of fancy to ascribe similar powers to the stars and planets, and to suppose that, separately or combined, their influence upon mundane affairs might be either benign or malignant. The supremacy of the sun was beyond question; the brilliance and variability of the moon were readily associated with like qualities in human beings; it was natural to name the magnificent leader of the planets "Jupiter" and give him Jovian attributes; no less so to connect the next beautiful orb with the goddess Venus and endow it with her qualities; to note the sanguinary hue of Mars and the unhealthy pallor of Saturn and regard each as fateful in its own way in its influence on the affairs of men..

Whether astrology should be counted among the "Follies of Science," or be rejected as simply an attempt at fraud, there can be little doubt that it belongs in the category of "Scientific Vagaries." So varied and at the same time so methodical are the movements and positions of the sun, moon, and stars, that they are readily arranged in an elaborate and very precise system, which is just what is needed and all that is needed for an all-embracing scheme of relationship between the stars and human affairs. It does not matter that

such a relationship has never been established, if there is no such relationship it can be assumed, and the scheme based upon it will be just as workable, and it is this relationship that constitutes astrology as that is thought of nowadays,—"judicial astrology" as it used to be called, to distinguish it from astronomy which is concerned only with the movements, position, physical nature and condition of these same bodies.

Astrology is so convenient a source of information concerning the future, and the grounds for belief in it are so agreeable to one's fancy, that its dupes could follow its indications without feeling that they were superstitious. Especially was it of value to royalty. In the Middle Ages an astrologer was a royal perquisite; a court astrologer was hardly less necessary than a court jester, even if he were not of as much real use. Thomas Watson says of the French king Charles the Wise (1364 to 1380), "For all his wisdom, Charles was a firm believer in astrology, and a state astrologer was one of the honored and salaried officials of his administration. It was this man's sworn duty to tell the King what was going to happen, so that the King *might take measures to keep it from happening.*" (*The Story of France,* Vol. I, p. 221). The prediction was usually ambiguous, and whether it was fulfilled or not, the astrologer stood to win in either case. If he foretold disaster and it came, fate was inexorable; if it did not come it was averted by the measures which his royal master put into effect by reason of the timely warning, and the seer and his wonderful science were alike vindicated. Another notable instance of this kind was the Emperor Rudolf II, of Bohemia, whose devotion to the mystic sciences is more closely associated with Alchemy. As late as the seventeenth century astronomers sometimes practiced astrology, and the fact that Kepler did so is played by its advocates as a trump card in its favor, and as evidence that an unprejudiced judge will concede a scientific character to the cult; but they evade the fact that Kepler denied any right

of astrology to be considered scientific, and that his own use of it was to make horoscopes as pot boilers. As related to astronomy astrology is neither parent, child, sister, nor handmaid; rather it is like a cuckoo in a sparrow's nest. Wallenstein, the Field Marshal of the Imperial armies in the Thirty Years' War, relied much upon his astrologer whom he kept always at hand. We have no record of any actual horoscope which this astrologer made for his master, but there is one in existence that is reputed to have been set by the astronomer Kepler. It is here shown but its interpre-



Kepler's Horoscope of Field Marshal Wallenstein.

tation is not given. Evidently, however, it failed to warn the general of his assassination which occurred at Eger in 1634.

By the middle of the eighteenth century astrologers had greatly increased in number and, with few exceptions, had so deteriorated in ability that the practice of their art had

degenerated into mere fortune telling. From the middle of the eighteenth to the middle of the nineteenth century it seemed to be part of an orgy of fortune telling, dream interpretation, clairvoyance, spirit rapping, and other forms of mysticism or occultism that marked that period. It seems remarkable that the present day of larger and more generally diffused knowledge should witness a recrudescence of the practice. Its friends explain this by saying that the renewal of interest is just *because of that larger and more widely diffused learning.*

The most celebrated astrologer of the sixteenth century, and perhaps the most famous in all history, was Michel de Notre Dame, more commonly known by his latinized name Nostradamus (1503—1566). He has been called "The King of Astrologers." He was court physician, a prolific writer, and issued common fortune-telling books besides numerous prognostications in a more dignified form, but his fame as an astrologer rests mainly upon twelve so-called "Centuries"—a Century being one hundred metrical stanzas of four lines each, and each quatrain containing one or more prophecies. These Centuries as well as his other works have been translated into many languages and often republished. The Centuries appeared between 1555 and 1558. For some of the prophecies it has been possible to find an explicit fulfillment in history, while others are inexplicable (as yet), and many are obscure or equivocal. A good specimen is Quatrain 33, of Cent. V, supposedly relating to the *Noyades* of Nantes:

"Des principaux de cite rebelle
Qui tiendront fort pour liberte r'avoir,
Detrancher masles, infelice meslee
Cris, hurlemens a Nantes piteux voir."

Says Bareste,

"We shall not interpret this intelligible quatrain, we will only translate it:—The authorities of the city in full rebellion, under

pretext of defending liberty, shall have the people massacred, commingling ages and sexes, amid cries and shrieks. Nantes will present the most horrible spectacle." (*Nostradamus, par Eugene Bareste, Paris 1840.*)

It is the misfortune of astrological as of other prophecies that it does not become quite clear what they mean until they have been fulfilled. Undoubtedly the world's experiences in the six years from 1914 to 1920 furnish a superabundance of material for the verification of prophecies that are at all equivocal in terms, or that predict evil and disaster, and a new scrutiny of these old "Centuries" might now find that they fit the recent world war better than earlier events.

The plate is a reproduction of the frontispiece of an edition of Nostradamus' prophecies translated into English by Theophilus de Garencieres, and published in 1672. It is of interest because it exhibits admirably the spirit of astrology and of its devotees.

Who could be "a trusty friend in times of uncertainty" so well as he who could discern the future? "For he will always be a God to me," is the natural tribute of a worshipper; and the legend "I am again coming into being from an existence in ancient times" is the Pythagorean doctrine of reincarnation, inculcated by every master of this art. It is a most delightful doctrine for the diviner, for it leaves his fancy free of trammels, to roam through the past, or to indulge in extravagances for the future.

In his life of Nostradamus, Bareste gives "explications" of many of the prophecies, up to the date of the work, 1840, but quotes the astrologer's own statement that his prophecies extended nineteen hundred and fifty-seven years later. "*. . . Et sont perpetuelles vaticinations pour d'ici (1555) a l'annee 3797.*"

Again, in his interpretation of the quatrains, Bareste

cites three separate passages which are supposed to indicate the Massacre of Saint Bartholomew (1572), and says in effect, "If you doubt that you'll doubt anything."

"Si apres avoir cite de telles choses il reste encore des incredules, c'est que l'incredulite est indestructible."

Of course the astrologer would figure in romantic literature, and we find both Goethe and Schiller making use of him. In the opening scene of Goethe's masterpiece Faust refers to

"... this book of mysteries,
From Nostradamus' own hand"

as his guide.

A good idea of what astrology had come to be by the seventeenth century can be had from a compendium written by one of the most skilful exponents of it at that time, the English astrologer William Lilly, who published a complete exposition of its theory and practice, about the year 1640. This gives in greatest detail the ideas and methods of the art of astrology as most approved at that time, gathered from the records of many centuries preceding. A few extracts from the work will exhibit the general character of the belief and practice to which astrology had then attained.

The author seems to have been taken to task by his fellow practitioners for giving away the secrets of the trade and endangering their livelihood, and they give him pretty plainly to understand that they think that he has profited unfairly by doing so, but he assumes a most virtuous air throughout and, whether sincerely or not, in the preface he says

"... notwithstanding the importunities of some, and they are not few, who deemed I should not deliver the Art in so plain and easie a method, yet I professe, their words rather invited me to discover all I knew, then to conceale one sillable materiall."*

* *Christian Astrology Modestly Treated of, in Three Books.* William Lilly, London, 1647.

Seemingly he would pose as an unselfish benefactor adhering strictly to the golden rule.

The foundation on which the structure of astrology rests is the zodiac. It is not necessary to present this fully but some explanation may help to show the connection of astrology with astronomy. In the period of a year required by the earth to perform its revolution around the sun, the latter, as seen from the earth, is projected successively, from day to day, against every point of a circle of the heavens. To an observer unconscious of the motion of the earth around the sun, it is apparently the sun that describes an orbit, just as it seems to go from the eastern to the western horizon every day, and this apparent path of the sun among the stars for the whole year, spread to a width of about sixteen degrees, is the zodiac. Within that belt of the heavens lie the planets and many of the principal constellations, and therefore most of astrology is associated with it. To quote from Lilly:

"The whole Zodiack is divided into twelve equal parts, which we call Signs, and give them the names of living Creatures, either for their properties they hold with living Creatures, or by reason of the scituation of the Starres in those places which somewhat resemble that effigies and similitude of living creatures: Their names and character follow:

(*Christian Astrology*).

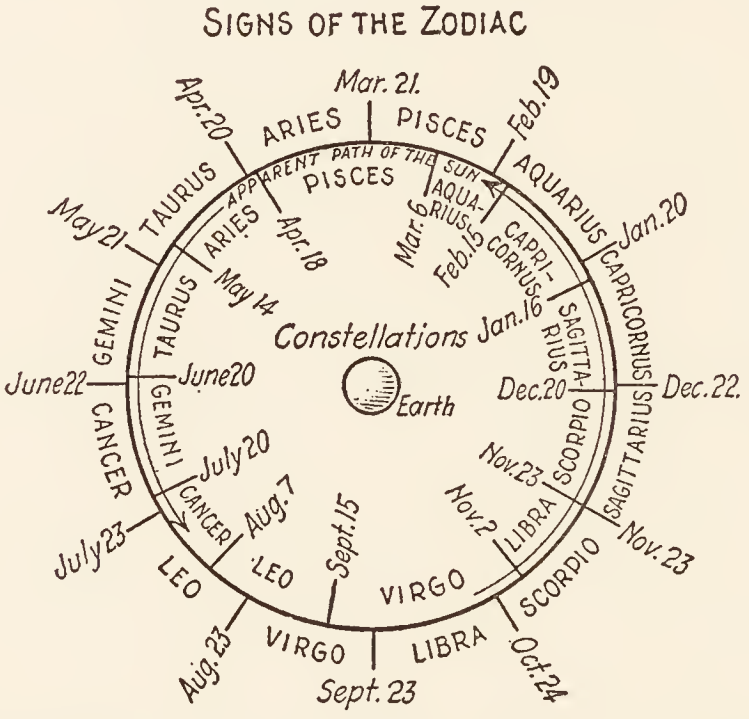
The "living creatures or effigies" represented by these symbols are the constellations, 1, Aries the Ram; 2, Taurus the Bull; 3, Gemini the Twins; 4, Cancer the Crab; 5, Leo the Lion; 6, Virgo the Virgin; 7, Libra the Balance; 8, Scorpio the Bcorpion; 9, Sagittarius the Bowman; 10, Capricornus the Goat; 11, Aquarius the Waterman; 12, Pisces the Fishes.

The sun completes the circuit of the twelve signs in a year, and astronomically, when it enters the sign Aries, the twenty-first of March, spring begins, and at quarterly intervals thereafter, each of the other seasons. The twelve constellations named above do not occupy equal spaces in the zodiacal belt; Virgo, for example, occupying more than forty-five degrees, or twice as much as Aries, but they are so distributed that when the circle was divided into twelve equal parts of thirty degrees, each of the divisions included the greater portion if not the whole of a constellation. At the present time, when the sun in his apparent motion is at the point of entering this first sign in his circuit, he is no longer projected against the constellation Aries in the heavens. The signs of the zodiac and the constellations corresponding to the same names coincided twenty-two centuries ago, but the peculiarity in the movement of the earth, or in the apparent movement of the sun around the earth, known as the precession of the equinoxes, has thrown the signs of the zodiac and the constellations of the heavens out of unison nearly thirty degrees, or one twelfth of a circuit in the twenty-two centuries. The present relative situation of the signs and the constellations is about as here shown.

When the sun is entering the sign Aries, March 21, he is only about one third of the way through the constellation Pisces; not until twenty-eight days later does he enter the constellation Aries, and then he is about passing out of the sign Aries. As a consequence of this change, the relation that was supposed to exist between the stars and the earth when the sun entered a given sign must steadily be changing in a disconcerting way. However the difficulty of adjusting the interpretations to correspond to this change is not insurmountable.

The constellations not only exerted an influence upon

the seasons of the year, but had direct relation to the various portions or organs of the human body, as is so vividly portrayed in the familiar figure that usually illustrates the domestic almanac of today, and which is here shown.



Relative Positions of the Zodiacal Signs and Constellations.

The circle of the horizon divides the sphere of the heavens into halves: the meridian circle again bisects these, thus making four equal parts or quadrants; by other meridians each quadrant is divided into three equal parts, thus making of the entire sphere twelve spaces called "houses." Concerning these we are told

"As before we have said there are twelve Signs and also twelve Houses of Heaven, so now we are come to relate the nature of these twelve houses. . . . There is nothing appertaining to the life of man in this world, which in one way or other hath not relation to one of the twelve Houses of Heaven, and as the twelve Signes are appropriate to the particular members of Mans body; so also doe the twelve houses represent not onely the severall parts of man, but his actions, quality of life and living, and the curiosity and judgment of our Forefathers in Astrology, was such, as they have alotted to every house a particular signification, and so distinguished humane accidents throughout the whole twelve houses, as he that

understands Questions appertaining to each of them, shall not want sufficient grounds whereon to judge or give a rationall answer upon any contingent accident, and successe thereof." (Lilly, *Christian Astrology.*)

The Anatomy of Man's Body as Governed by the Twelve Signs and the Periods when such Sign is in Control through the Influence of the Sun, according to Ancient Astrology.

Head and Face Aries ♈ Mch. 21—Apr. 19

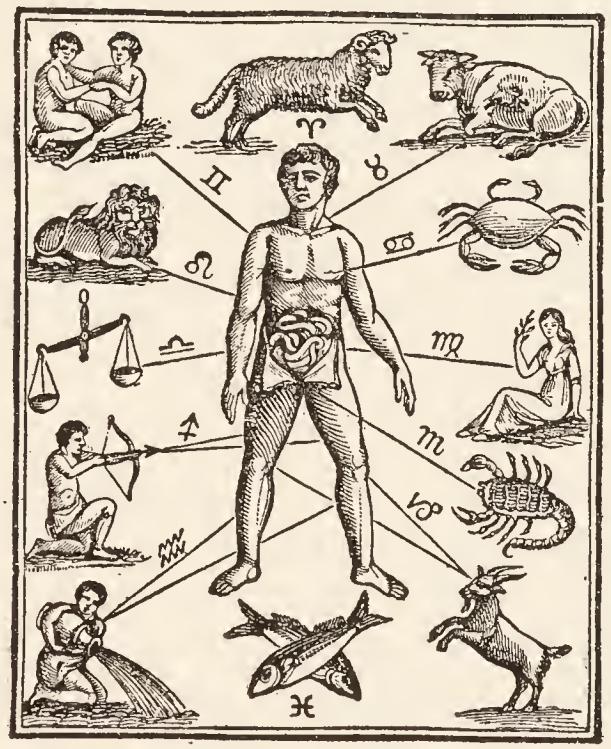
Arms.
Gemini ♊
May 21—June 21

Heart.
Leo ♌
July 23—Aug. 22

Reins.
Libra ♎
Sept. 24—Oct. 23

Thighs.
Sagittarius ♐
Nov. 23—Dec. 21

Legs.
Aquarius ♒
Jan. 21—Feb. 19



Neck.
♉ Taurus
Apr. 20—May 20

Breast.
♋ Cancer
June 22—July 22

Bowels.
♍ Virgo
Aug. 23—Sept. 23

Secrets.
♏ Scorpio
Oct. 24—Nov. 22

Knees.
♑ Capricornus
Dec. 22—Jan. 20

Feet Pisces ♓ Feb. 20—Mch. 20.

The Different Parts of the Human Body, as Governed by the Signs of the Zodiac.

Could any scheme be more comprehensive? As "there is nothing appertaining to the life of man which in one way or other hath not relation to one of the twelve Houses" there is no limit to the range of Astrology in interpreting or forecasting. What may it not do? One votary appeals to it to decide a question of life and death, and another finds it a safe monitor to pick the winner in a horse race. The author then gives a complete account of each "House," with its "Nature and Signification." The twelfth will serve as well as any for illustration:

"*The Twelfth House.*

"It hath signification of private Enemies, of Witches, great Cattle, as Horses, Oxen, Elephants, &c., Sorrow, Tribulation, Imprisonments, all manner of affliction, self-undoing, &c., and of such men as maliciously undermine their neighbors, or inform secretly against them.

It hath significators ♓ and ♀" (Sign *Pisces* and planet *Venus*); "Saturn doth much joy in that House, For naturally Saturn is author of mischief; and it ruleth in Mans body the feet.

In colour it presents the Green.

Its a Cadent House, Feminine, and vulgarly sometimes called *Cataphora,* as all Cadent Houses may be. This is the true Caracter of the severall Houses, according to the *Ptolemeian* Doctrine, and the experience myself have had for some years; I must confesse the *Arabians* have made severall other divisions of the Houses, but I could never in my practise finde any verity in them, wherefore I say nothing of them."

Which is to say that the general experience of astrologers, including his own, fully established the verity of the divisions as he published them. So it would seem that the fate that is in store for any one would depend upon the astrologer from whom he is to learn it, or rather upon the particular system of astrology that is applied to his case, for the systems differed as does homeopathy from allopathy; but, as the author says, the practice of astrology is "easie" if one only learns the scheme. The phrase "naturally Saturn is the author of mischief" is an example of the assumptions upon which the interpretations proceed. When we consider, however, the elaborate measures to be taken, the precautions to avoid a misstep, the points to be considered in reading a nativity or casting a horoscope, notwithstanding the fact that the course of procedure is distinctly stated, we cannot wonder that the astrologer readily comes to think he is doing something, or if not that, to make his client think so,—which is just as good,—and his client may be the ruler of a nation or the leader of an army.

The twelve houses were represented in a diagram by the twelve triangular spaces that surround a central square as in the figure on page 22. The lines between the houses are called cusps.

In reading a nativity or making a horoscope the first thing to do was to "erect" or "set your Figure," which means to place the Signs and Planets upon the Houses properly for the date of birth, as exactly as it may be known to the year, month, day, hour, and minute.

The Astrologer has a Table of Houses in twelve pages, one page for the sun in each of the twelve signs in succession, and six columns for this sign and the next five in the Houses from the twelfth to the sixth, and providing for each hour of the day. The six opposite signs go to the six opposite houses, 1st being opposite to 7th, 2d opposite to 8th, and so on.

To erect a Figure: from the Ephemeris find the true place of the sun in the Sign, for the given date. Then, by means of the Table of Houses, from this position of the sun are found in succession the positions of the signs for all the houses, and the positions are carefully marked on the diagram of the Twelve Houses. Next, a somewhat similar process locates all the planets relatively to the Houses, and their positions are also recorded on the diagram, and the figure is complete. (This is the solar horoscope, and is critized by modern astrologers.) The procedure is given in great detail and very explicitly, and on these relative positions,—conjunction, or opposition, or other angular relation, with the especial character and influence that are attributed to the respective heavenly bodies, the entire reading is effected. So extensive and so complete is the apportionment of human affairs and human destiny to the various Houses, and so exactly and so definitely are the character and influence of each of the planets stated, that in truth there is no question relating to human ex-

perience that cannot be answered—the prospect of a long life or an early death; of wealth or poverty; of success or failure in an undertaking; of marriage or celibacy; of health or sickness; all these were revealed to the inquiring astrologer by the stars that were at once the signs and the arbiters of Fate.

The old diagram of the twelve houses has been discarded to a large extent, and a circular arrangement is now more commonly adopted.

A Modern Diagram of the Twelve Houses.

The very essence of astrology is its definiteness and orderliness; any suggestion of mutability in the planetary system is a blow at the science. A system that is based upon the Ptolemaic astronomy which is all complete, and is limited by the sun, moon, and six planets, cannot but be profoundly disturbed by the discovery of other heavenly bodies, and this was the fate that was to befall astrology. It was bad enough when Galileo began discovering moons circling around Jupiter; that put astronomers and theologians at loggerheads and led to angry discussions among them, but astrology was not then too ironbound to admit of slight adjustment. The introduction of a new planet was like the proverbial monkey-

wrench in smoothly running machinery. Such was the advent in 1781 of Uranus, or Herschel as it was first called The new planet was soon found to be a large and important member of the Sun's family, and here was a pretty kettle of fish for the astrologers. There was no gainsaying the discovery—astronomy had become too exact a science for that—and the astrologers of the nineteenth century had to do a good deal of revising. What was to be done? Were the earlier astrologers to be discredited, or did not Uranus count for anything? They perceived the dilemma, for we find R. C. Smith, an English astrologer, writer and editor of astrological works under the pseudonym "Raphael," inveighing against the errors that had crept into the practice of his art which, freed from them, is altogether admirable. He says:

"The imperfections in the art, caused by the non discovery of *Herschel* (a planet of prodigious power in all nativities and themes of heaven), and an ignorance of the laws relative to comets and various celestial phenomena, were sufficient to cause a host of erroneous theories, or, as we now term them, 'Ancient superstitions.' Of which one of the most curious is THE KNOWLEDGE OF FATE BY THE SOLAR HOROSCOPE." * So, while the Figure is still erected in the twelve houses, the new planet ♅ is inserted, and the influence of the moon is more powerful and, in his view, it is the moon when in the successive signs of the zodiac, that rules the portions of the human body assigned formerly to the sun when in the same signs, as shown in figure on p. 29. The name Herschel which was given to the seventh planet soon after its discovery by William Herschel in 1781 was later changed to Uranus, the name by which it is now designated. It is symbolized by the same character as Venus but inverted, ♅, though the early symbol, an H with a pendant, is used occasionally.

* *The Familiar Astrologer,* by Raphael, London, 1831.

In 1846 the planet Neptune was discovered and this again complicated prognostications. It did astrology a good service, however, for it seems to have led its professors to take more nearly a scientific attitude than they had done previously. We are told even now, after the lapse of more than seventy years, that the effect of Neptune is variable, and that its influence is not yet very well known. The implication seems to be that it is better to wait until there are enough data in connection with notable events or people to make an interpretation that will take account of Neptune and still fit the facts. That is, assign to this planet attributes and a significance to accord with known facts rather than assume qualities and read the nativity according to those assumptions. Still, something had to be done with Neptune, and he is supposed to strengthen the influence of another planet when in conjunction with it, and to weaken its influence when in opposition;—ingenious enough even if somewhat hedging.

If now the intra-Mercurian Vulcan should prove to be a fact, and the suspected extra-Neptunian planet be added to the list of those already known, it will be adding new complications before the present ones are untangled.

The moon as well as the sun passes through the twelve signs of the zodiac in its revolution once around the earth, and as the influence of the moon upon the fate of an individual is so powerful, the position of the moon in the zodiac at the time of one's birth is of greater importance even than that of the sun. It is therefore of the highest importance to be born under the right sign. Popular notions of lucky and unlucky days, legends of fortune, etc., are often expressed in a jingle like the following, giving the significance of the moon's position upon one's nativity. It is quoted by "Raphael" as among "ANCIENT TRADITIONS" whose utility is dubious. Its dubiety, however, seems to arise only from its omitting to take account of the effect of other heavenly bodies besides the moon.

"The moon in *Aries,* life is long,
In *Taurus, Gemini, Cancer,* strong!
But when the moon in *Leo* strives,
Full short and painful are men's lives!
In *Virgo* thou'lt behold her true!
Happy and just, and amorous too!
But still men's years are short and few!
Then view her swift through *Libra* speed;
The vital flame she'll constant feed,
And famous make in act and deed!
Wail! when in *Scorpio* she pursues,
The *Sagittarian* arrow! Thews,
And Sinews potent grace this latter Sign!
Long life and happy then is thine!
In *Capricornus,* in *Aquarius* short,
But *Pisces* constant wards the fatal dart."

From 1915 to 1920 the English astrological almanacs Zadkiel's and Raphael's were rich in data connected with the war. Each year they published predictions for the next one and called attention to many for the preceding year that had been fulfilled. The predictions cited in Zadkiel's for 1917 are in vague terms, but their fulfilment is shown in specific, precise instances of victory or misfortune for the *entente* allies and disaster for the central powers. Raphael took a longer chance and predicted the death of the Kaiser in 1917, and in 1918 he makes a rather limping comment on the failure of the arch-enemy to comply with the prediction.

It was a favorite practice of astrologers to call themselves "Philomaths," and the more pronounced their charlatanry the more they resorted to factitious titles to bolster up their pretensions. With his quaint humor Dr. Franklin did not fail to add that artistic touch in affixing the title "Philomath" to the name of Richard Saunders, the author of "Poor Richard's Almanack."

A recent American treatise on Astrology contains the horoscopes of numerous prominent persons of today, but

their interpretations are guarded in expression. As an example, in the horoscope of Albert, King of the Belgians,

"Uranus in the second house in opposition to Venus in the ninth shows the *loss of fortune through idealism, although the exaltation of Venus in the mid-heaven would presage the victory of those same ideas.*" (*Stars of Destiny,* by Katherine Taylor Sprague, New York, 1916.)

(Italics are ours.) Has not that been found literally correct? In the first issue of Poor Richard's Almanack is a prediction of similar tenor in the weather forecast for January 7 and 8: "snow, *if not too warm,* about this time"!

The sun and planets, with their symbols, and a very brief statement of what they signify, are as follows:

☉ Sun. Represents kings, princes, occupations; governs heart and brain. Metal, gold.

☽ Moon. Signifies people in general, particular women, also travelers, etc. Rules the eyesight. Metal, silver.

☿ Mercury. Signifies literary persons, orators, scholars. Rules the brain, memory, the wit. Metal, quicksilver.

♀ Venus. Signifies musicians, painters, artists, professions of adornment. Planet of love, happiness and ease; is called the "lesser benefic."

♂ Mars. Soldiers, sailors, conquerors, tyrants, etc. Metal, steel.

♃ Jupiter. The "greater benefic"; planet of wealth and greatness, judges, and civil authorities.

♄ Saturn. Old men, miners, laborers, etc.

♅ Uranus or Herschel. Discoverers, inventors, *astrologers,* etc. Rules laboratories, furnaces, old quaint places and things.

♆ Neptune. Mystics, dreamers, seers, psychics, etc.

Surely this last would have been the proper class for astrol-

ogers, but they had already been placed under the influence of Herschel, before Neptune was discovered.

Astrology proceeds upon one of the most complete and highly refined systems ever devised, and that is sufficient to make it fascinating without any necessity for correctness in its principles. In comparison with this, all other methods of fortune telling are as base metal to pure gold. (See Appendix I.)

REFERENCES

Stars of Destiny; Katherine Taylor Craig, New York.

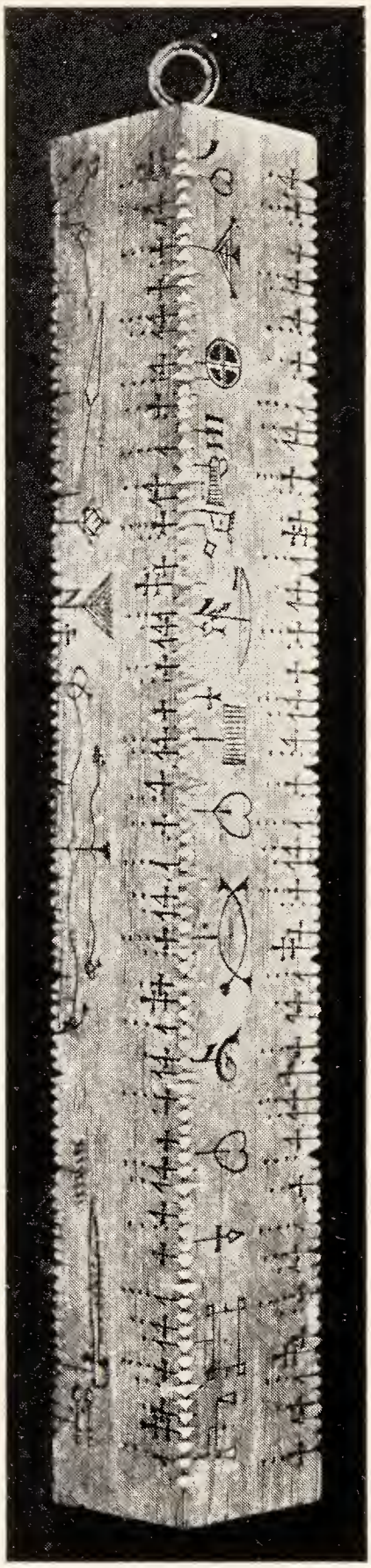
Christian Astrology Modestly Treated of, in Three Books; William Lilly. London, 1647.

The True Prophecies or Prognostications of Michael Nostradamus, Physician to Henry II, Francis II, and Charles IX, Kings of France, And One of the best Astronomers that ever were. Translated and Commented by Theophilus de Garenciéres. Doctor in Physick, Coll. Lond. London, 1672.

The Familiar Astrologer; an easy guide to Fate, Destiny, and Foreknowledge. By Raphael (Pseud. for R. C. Smith), London, 1831.

(A rare volume, with colored steel engravings, numerous "nativities" fully interpreted, and old stories of witches, magic, and tricks. D. W. H.)

(*a*)



(*b*)

A "Clog" Almanac of the seventeenth century

Photographed from a "clog" reconstructed by the author, from Dr. Plot's illustrations

ALMANACS

It is not easy to find out just what is an almanac, for authorities are guarded in their explanations, and dictionaries and encyclopedias are confusing rather than helpful. The name has supplied lexicographers with a choice bone of contention: the oracular Dr. Johnson gives its derivation from the "Arabick" which others dispute with glee, and defines it "A calendar; a book in which the revolutions of the seasons, with the return of feasts and fasts, is noted for the ensuing year." His contemporary, the venerable Ainsworth, in his dictionary as highly amended by the Reverend Dr. Thomas Morell (MDCCLXXIII), tells us briefly that an "almanack" is an *Ephemeris,* with a particular mark to "Ephemeris" to inform us that that word is Greek! Thomas Sheridan, about the same time (MDCCLXXX), defines almanack "A Calendar" and then "Calendar, A Register of the year, in which the months, and stated times, are marked, as festivals on holidays." Coming along to 1837, some sixty years nearer to modern usage, Charles Richardson's "New Dictionary of the English Language" slips into a dispute as to the origin of the term which it says is "unsettled," and dodges all responsibility for its meaning by actually omitting any definition whatever. The Oxford Dictionary, just completed, does not clear up the fog—but of course we all know an almanac when we see it. In the early days of printed books and even after they became common, but prior to the daily newspapers and the general distribution of news by telegraph, a few books were the stand-by of most people in rural communities, the Bible of course being at the head, and next in importance to the Bible was the almanac—an institution almost as highly revered as the grandfather's clock.

The presumption is that an almanac exists primarily for

its calendar, and secondarily for its information of an astronomical nature or about such things as movable festivals, etc., which are determined from astronomical data, but modern users say " no " to that emphatically, for although these have been their ostensible purposes, for many years almanacs have been advertising mediums or instruments of propaganda, in which the calendar has played a minor rather than a major part; and yet, strangely enough, while the almanac is proclaiming loudly the tenets of some ism or the virtues of some medicine more than dubious in character, its humble calendar is quite reliable and is the only part of the book that is so. It is only the National Ephemeris or Nautical Almanac issued by some governments that is devoted wholly to astronomical information. The " Farmer's " almanac is not always sure of its ground, but there is no guesswork about the Nautical Almanac; its accuracy is deadly and its monotony deadening. It is about as futile to argue with an ephemeris as to quarrel with the equator.

In relation to science, or rather pseudo-science, almanacs have been employed chiefly in exploiting patent medicines and in weather forecasting.

Of late, almanacs have been converted into veritable encyclopedias of statistical information, and these, again, have been reduced to a special character, political, religious, social, or other. Wise saws, pieces of philosophy, advice on every conceivable subject, are given out through them. Perhaps the almanac can speak of such matters as well as any one else can, though why they should be in an almanac is not clear, but it is when the almanac undertakes the rôle of weather prophet that it exposes itself to criticism, and few of them seem able to resist the temptation to make weather forecasts as confidently as they predict eclipses, or announce the phases of the moon. It is with weather prophecies that we are most concerned here. Many newspapers issue almanacs. As an example, The World 1921 Almanac and Encyclopedia,

issued by the *New York World,* a bulky volume, containing over eight hundred and fifty pages of text and about three hundred and fifty pages of advertising, is an extensive, a varied, and valuable book of reference. The almanac proper, *i.e.,* the calendar with its astronomical data, requires twenty-six pages, and if it would only drop the other twelve hundred pages it would be a very good almanac, if not so much of an encyclopedia.

Prior to the introduction of national weather service, local prophets gained repute for local presaging, and the almanac was relied upon for long-distance or long-time predictions, and in the matter of weather forecasting it far outdid the weather bureaus, for it easily summed up the weather conditions day by day and month by month for a year in advance. If the almanac maker will only stick to astronomical grounds, he can have no difficulty in extending weather forecasts beyond a year. Any conclusion in respect to the weather which he can derive by reference to the stars inclines his readers to believe in it for it is by just such reference that eclipses, astronomical phenomena, and even the date of Easter are quite accurately predicted for an indefinite number of years.

One of the most interesting and most celebrated of American almanacs was " Poor Richard's," published for a quarter of a century by Dr. Benjamin Franklin. In the last column of the sample page interspersed among astronomical statements, are the homely maxims uttered by " Poor Richard " that have been widely circulated and often quoted. The reader of today is struck by the first statement on the January page, namely, that January is the eleventh month: a fact at that time though it has been reckoned in England and North America as the first month of the year since 1752, when the Gregorian calendar went into legal effect in Great Britain. Although Franklin had not acquired any extended reputation for scientific attainments when he began his almanac (his famous kite experi-

ment was made in June, 1752), long before he ceased to publish it his word upon topics of physical science commanded respect from all classes, yet his position of authority in such matters did not deter him from printing the absurd

Poor Richard, 1736.

AN

Almanack

For the Year of Chriſt

1 7 3 6,

Being *BISSEXTILE* or LEAP YEAR

And makes ſince the Creation	Years
By the Account of the Eaſtern *Greeks*	7244
By the Latin Church, when ☉ ent. ♈	6935
By the Computation of *W. W.*	5745
By the *Roman* Chronology	5685
By the *Jewiſh* Rabbies	5497

Wherein is contained,

The Lunations, Eclipſes, Judgment of the Weather, Spring Tides, Planets Motions & mutual Aſpects, Sun and Moon's Riſing and Setting, Length of Days, Time of High Water, Fairs, Courts, and obſervable Days.

Fitted to the Latitude of Forty Degrees, and a Meridian of Five Hours Weſt from *London*, but may without ſenſible Error, ſerve all the adjacent Places, even from *Newfoundland* to *South-Carolina*.

By *RICHARD SAUNDERS*, Philom.

PHILADELPHIA:
Printed and ſold by *B. FRANKLIN*, at the New Printing-Office near the Market.

Facsimile of Title Page of Poor Richard, for 1736.
(From Original in New York Public Library.)

weather prognostications found in the third column for each month. It is not likely that he meant them for anything more than his guess at what he thought "seasonable weather," but many of his readers were as ready to swear by his almanac as by their Bible, and had as much faith in the literal accuracy

of the one as the other. And the higher his credit rose as a scientist the more ready they were to rely upon his predictions of the weather.

XI Mon. January hath xxxi days.

More nice than wiſe.

Old Batchelor would have a Wife that's wiſe,
Fair, rich, and young, a Maiden for his Bed;
Not proud, nor churliſh, but of faultleſs ſize;
A Country Houſwife in the City bred.
He's a nice Fool, and long in vain hath ſtaid;
He ſhould beſpeak her, there's none ready made.

1	2	Circumciſion	12	♐	R. ☉ S.			Sun riſe 7 15
2	3	7 * ſou. 7 51 Ev.	1	24	7	14	5	☽ riſe 4 5 *morn*
3	4	♂ ☉ ☿ *Windy &*	1h	♑	7	14	5	New ☽ 4 day
4	5	Day 9 h. 34 m.	2h	20	7	13	5	at 8 Aftern.
5	6	✶ ♃ ☿ *falling wea.*	3	♒	7	12	5	*Never ſpare the*
6	7	Epiphany □ ♃ ♀	4	19	7	12	5	*Parſon's wine,*
7	G	*ſnow if not too warm*	5	♓	7	11	5	☽ ſets 8 13 aft.
8	2	*about this time.*	6	17	7	10	5	*nor the Baker's*
9	3	☉ ent ♒	6h	♈	7	9	5	*pudding.*
10	4	Days incr. 30 m.	7	16	7	8	5	Firſt Quarter.
11	5	*Windy and*	8	♉	7	8	5	*Viſits ſhould be*
12	6	7 * ſouth 7 13	9	14	7	7	5	*ſhort, like a win-*
13	7	*cloudy.*	10	28	7	6	5	☽ ſets at 2 morn
14	G	2 Sund. aft. Ep.	10	♊	7	5	5	*ters day, Leſt*
15	2	7 * ſo. 6 56	11	25	7	4	5	*you're too trouble-*
16	3	*Falling wea. windy*	12	♋	7	3	5	*ſom haſten away.*
17	4	□ ☉ ♃ *moderate*	1	22	7	2	5	☽ ſets 5 54 mo.
18	5	*ſnow or rain.*	2	♌	7	1	5	Full ● 18 day
19	6	Days 10 hours.	2h	19	7	0	5	9 at night.
20	7	✶ ☉ ♄	3	♍	6	59	6	
21	G	Septuageſima	4	13	6	58	6	*A houſe without*
22	2	7 * ſouth 6 32	5	26	6	57	6	*woman & Fire-*
23	3	*There will be more*	6	♎	6	56	6	☽ riſes 10 aft.
24	4	□ ♄ ♀ *cold rain,*	6h	20	6	55	6	*light, is like a*
25	5	Days 10 h. 12 m.	7	♏	6	54	6	*body without ſoul*
26	6	*or ſnow.*	8	14	6	53	6	*or ſprite.*
27	7		9	26	6	52	6	Laſt Q. 26 day.
28	G	Sexageſ. *Clear but*	10	♐	6	51	6	☽ riſ. 1 50 mor.
29	2	*ſharp and cold,*	10	20	6	50	6	*Kings & Bears*
30	3	K. Cha. I. decol.	11	♑	6	48	6	*often worry their*
31	4	*Froſts.*	12	16	6	47	6	*keepers.*

Sample page from the First Number of Poor Richard's Almanack, 1733. (Seven tenths of size of original.)

Poor Richard shifts responsibility for mistakes in the weather predictions by his quizzical preface to the almanack for 1737, which is a thoroughly characteristic specimen of his humor. He says:

"As to the weather, if I was to fall into the method my brother *J————n* sometimes uses, and tell you, *Snow here or in New*

England,—Rain here or in South Carolina,—Cold to the northward, —Warm to the southward, and the like, whatever errors I might commit, I should be something more secure of not being detected in them. But I consider, it will be of no service to anybody to know what weather it is 1000 miles off, and therefore I always set down positively what weather my reader will have, be he where he will at the time. We modestly desire only the favorable allowance of *a day or two before,* and *a day or two after* the precise day against which the weather is set, and if it does not come to pass accordingly, let the fault be laid upon the printer, who, 'tis very like, may have transpos'd or misplac'd it, perhaps for the conveniency of putting in his holidays: and since, in spight of all I can say, people will give him great part of the credit of making my Almanacks, 'tis but reasonable he should take some share of the blame."

Franklin was an incorrigible wit, and would have his joke, certainly not less in his almanac than in signing the Declaration of Independence.

The almanac, in some instances, has been resorted to primarily as a vehicle of humor.

Josh Billings' "Farmer's Allminax" travesties everything, including what its author terms his "Zodiack Family" of which he gives a new variant every year. Imitating the more sedate almanacs, he is careful to string his weather "Prognostix" from the top to the bottom of the page, one of his best being near the beginning of the first volume: For Jan. 5, 1870, he predicts "*perhaps rain, perhaps not.*" Such an attempt at long sustained humor is likely to become mere flippancy at times—spontaneous humor cannot be made to order.

A famous almanac, p. 47, that has been published continuously, in English and German, for over a century goes to the other extreme. It is a good almanac in the true sense; it offers occasional literary paragraphs, and gives advice to farmers and their wives, but any flickering attempt at humor is apt to be heavy, and gives the impression of having crept in unawares. It is a typical old "Farmer's Almanac," with

the " Man of the Signs," that wonderful anatomical display of a human being with outstretched limbs and exposed viscera, corresponding to zodiacal signs; and the quaint old wood cuts showing occupations that mark each month's work for the farmer. Catering to no cult like astrology; eschewing, for the most part, advertisements of patent medicines or other nostrums, but sticking closely to business—almanac business; like *Poor Richard* it came to be a family friend throughout the community which it serves, and is now so mellowed by age that it has all the charm of an antique. These old-time almanacs were a family institution. Men in a reminiscent mood grow sentimental over them and write poems about them, just as they do of " The House Where I Was Born," " The Old Oaken Bucket," or " The Tree " the Woodman was implored to spare.

For many years this almanac, along with many others, has given the following scheme for predicting the weather, but it does not state whether its own conjectures are drawn from it. This table was originally approved by Sir John Herschel.

That this eminent sponsor of the table afterwards repudiated it as not well substantiated need not worry the almanac maker, since this is still probably as good as any other scheme for its purpose.

As may be seen, if it is desired to know, from this, what kind of weather would occur on, say, a given day in September or March, it will make a difference whether the time is regarded as summer or winter.

In this scheme the change of weather and the weather immediately to ensue are determined by the exact hour when the moon enters upon a particular phase. Now when it is " new moon " at one place on earth it is new moon all over the earth, but the character of the weather, and the kind of change that is coming at any instant are of the utmost variability—instead of being alike all over the world.

WEATHER PRONOSTICATOR

A Table for Foretelling the Weather through all the Lunations of each Year

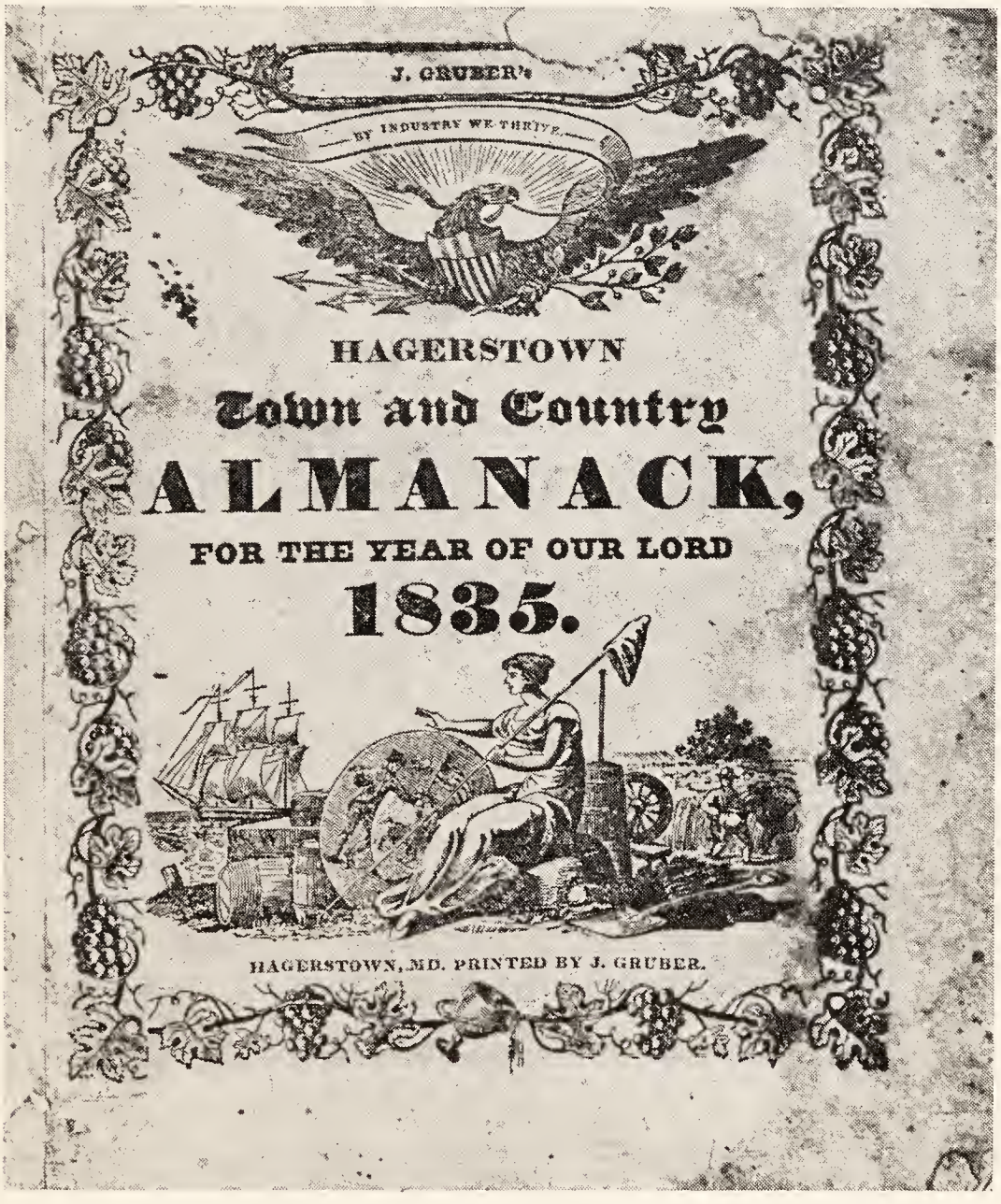
If the new moon, first quarter, full moon, or last quarter happen.	In Summer.	In Winter.
Btw. midnight and 2 in the morning	Fair	Hard frost, unless wind be S. or S.W.
Btw. 2 and 4 morning	Cold, with frequent showers	Snow and stormy.
Btw. 4 and 6 morning	Rain	Rain.
Btw. 6 and 8 morning	Wind and rain	Stormy.
Btw. 8 and 10 morning	Changeable	Cold rain, if wind be W.; snow, if E.
Btw. 10 and 12 morning	Frequent showers	Cold & high wind.
At 12 o'clock at noon and 2 in the afternoon	Very rainy	Snow or rain.
Btw. 2 and 4 in afternoon	Changeable	Fair and mild.
Btw. 4 and 6 in afternoon	Fair	Fair.
Btw. 6 and 8 in afternoon	Fair, if wind N.W.	Fair and frosty, if wind N. or N.E.
	Rainy, if S. or S.W.	Rain or snow, if S. or S.W.
Btw. 8 and 10 afternoon	Ditto	Ditto.
Btw. 10 and midnight	Fair	Fair and frosty.

This table is the result of many years' actual observation; being constructed on a due consideration of the attraction of the Sun and Moon, in their several positions respecting the earth; and will, by simple inspection, show the observer what kind of weather will most probably follow the entrance of the Moon into any of her quarters, and that so near the truth as to be seldom or never found to fail.

The old reliable domestic almanac for New England is The Old Farmer's Almanac, by Robert B. Thomas, of which the issue for 1920 is No. 128. This and Gruber's are probably the oldest uninterrupted publications of the kind in America. "Farmer" Thomas' Almanack has had the good fortune to be enshrined in its own special literary niche by Professor George Lyman Kittredge who has written a most entertaining and informing discursive volume about it.

Not infrequently a proprietary almanac is combined with a magazine of some special character. Two noted instances

of this are Raphael's *Almanac or The Prophetic Messenger and Weather Guide,* published in England annually since 1820; and Zadkiel's *Almanac and Ephemeris,* also English, issued since 1830. Both are Journals of Astrology, and abound in astrological information and predictions. Both



(*Reproduced by Permission o Gruber Almanack Company.*)
One-half size of the original.
Title page of J. Gruber's Almanac.

"Raphael" and "Zadkiel" are pseudonyms, the former for R. C. Smith who died in 1832, and the latter for Richard James Morrison, who died 1874, but the almanacs have been continued in their name. Ardent advocates and apos-

tles of a pseudo-science, it is fitting that they should write over a pseudo-signature. Both of these almanacs give good astronomical as well as astrological data. Both make predictions freely concerning people and events for the ensuing year, and dwell upon the predictions of the previous year that have been fulfilled, omitting usually to speak of those that failed. Both forecast the weather for the entire year, systematically appending a weather guide to the page for each month.

Especially is such an almanac the farmer's friend for it keeps him advised as to the weather, and upon nothing else does the success of his crops depend so much as upon the weather. But if he heeds astrology he will not expect that those planetary influences that are most conducive to the growth of plants producing fruits in the air would at the same time be most effective with tubers and roots. So he must be heedful of the " sign " the moon may be in, to determine when he would sow his wheat, plant his potatoes, or cut his briars and to a considerable degree he still does heed it. These superstitions die out very slowly.

Old Moore's Almanack is a familar household friend in England, and combines a number of characteristics. It is a farmer's almanac, and a propaganda of patent medicines and, most important of all, it contains the astrological omens for the month. It is among the oldest of the English almanacs, being a continuation of *Vox Stellarum* of Francis Moore (1657–1715?), which the *Encyclopaedia Britannica* says is the most famous of all the Stationers' Company's predicting almanacs, and dates from 1700.

The various forms which the calendar has assumed in different countries and at different times make an interesting study but one that is beyond our present purpose. In its best state the calendar is imperfect in various respects, and efforts to reform it are reflected in almanacs or special publications from time to time. A comparatively

recent one makes a strong plea for a division of the year into thirteen (lunar) months.*

The "Clog" (Wood Log) almanac, p. 38, was a form in use in England before printing was invented, but was retained in some parts of northern England nearly as late as the year 1700. It was a four-sided stick, the four corners of which represented the four quarters of the year, each edge being cut with notches for the successive days. To each edge of the stick belongs one half of each of the two faces that form the edge. Information for the people, so far as it was disseminated, was given out by the monks and priests, and these almanacs were in their hands. By a metal ring in the top the stick was

"chained to the altars of the monasteries and early churches, to be handy for the abbot or priest to refer to when giving his congregation notice of the coming festivals which are denoted by the hieroglyphic signs representing typical actions, offices or endowments of the Saints."

Sometimes dates for the agricultural work of the year were shown,

"but the priests discouraged such secular additions which enabled men to know the times of the year without attending church." (*The Rational Almanac,* M. B. Cotsworth.)

The Anglo-Dutch antiquary Richard Verstegan published a work entitled *A Restitution of Decayed Intelligence in Antiquities concerning the most noble and renowned English Nation; Antwerp, 1605,* in which, speaking of "Our antient Saxon ancestors," he says

"They used to engraue vpon certaine squared sticks about a foot in length, or shorter or longer, as they pleased, the courses of the moones of the whole yeare whereby they could alwayes certainely tel when the new moons, ful moons, & changes should happen, as also their festiual dayes, and such a carued sticke they called an **Al-mon-aght,** that is to say, Al-moon-heed, to wit, the regard or obseruation of all the moones, and here-hence is deryued the name of **Almanac**."

* *The Rational Almanac,* M. B. Cotsworth, York, England, 1905?

Efforts of etymologists to discover the derivation of the name trace it rather uncertainly through the Arabic and the Greek, philologists dismissing other conjectures as not deserving attention, but the above suggestion is at all events not wanting in plausibility. Al-mon-aght, pronounced rapidly or carelessly, easily becomes "almanac."

Dr. Robert Plot, the Oxford University professor of chemistry, in his *Natural History of Staffordshire, 1686,* gives a good authentic, and somewhat particularized description of the Clog almanac, which he found still in use in the north of England at that date, and of which the figures (*a*) and (*b*) are an illustration. In Fig. (*a*) the front edge is the first quarter of the year, Jan. 1–Mar. 31 incl., the right- and left-hand edges being notched for the second and fourth quarters respectively. In Fig. (*b*) the front edge shows the third quarter, July 1–Sept. 30 incl., the left and right-hand edges being the second and fourth quarters respectively. The first day of the month is marked by a flare ➤, and the notches for Sunday are deeper than the others. This is a "perpetual almanac" providing for nineteen years of the Julian calendar, in which that period comprises a "lunar cycle" of two hundred and thirty-five lunations. That is, on whatever days of the month the changes of the moon occur, in any given year, then in nineteen years after that the changes will occur again upon the same days of the month, so that a calendar that provides for nineteen years will repeat indefinitely. The change of the week day corresponding to the day of the month from year to year was easily adjusted by moving on one day at the beginning of each year or two days after leap year. The year illustrated began with Sunday (possibly 1683).

The Runic characters, dots, hooks, and crosses, at the left of each edge designate the astronomical features and are somewhat complicated.

They fix the changes of the moon by lunar months of

twenty-nine and thirty days alternately and link up the ecclesiastical calendar with the secular by means of the "lunar cycle" and the "golden numbers." (See Appendix II.) Apparently the saints' days and the church ceremonials were of more importance than secular affairs, but many of the latter which occured on fixed dates were marked by special symbols. All the dates and ceremonies connected with the Blessed Virgin Mary are marked by a heart. On the right, against the sixth of January is a star, the symbol of Epiphany, this being the date of "Old Christmas" or Twelfth Night; against the thirteenth St. Hilairy is shown by the bishop's double cross; the axe at January 25 indicates the conversion of St. Paul, and the mark against the first notch (New Year's) symbolizes the circumcision of Our Lord. Christmas was marked by a horn, the sign of health-drinking —"*notans cornus exhaurienda,*" quotes Dr. Plot. Against St. Valentine's day, February 14, the symbol is thought by some to be a wheel of fortune, by others a true lovers' knot; against St. David's day, March 1, a harp, because the Welsh saint used that instrument of praise. March 2, St. Caedda's day, has a bough, indicating the hermit's life which Caedda led in the woods near Lichfield. As St. John the Baptist was beheaded with a sword, his day, June 24, is so marked; and St. Lawrence's gridiron is placed upon his day, August 10. So, too, St. Catherine's wheel marked August 25, and St. Andrew's cross the last day of November. St. Clement's day was marked with a pot, referring to the custom of going about that night begging drink to make merry with. The pair of shoes October 25 was for St. Crispin, the patron saint of shoemakers. The curious inverted figure of a knight, connected with the 13th of October, attracts attention and deserves some explanation. It represents Edward the Confessor, who was canonized for his piety in life and the miracles wrought by his body after his death. He was buried in his newly consecrated church of St. Peter at Westminster,

Jan. 6, 1066, but after his canonization in 1161 the body of the new saint was first "translated" by Thomas à Becket Archbishop of Canterbury, in 1163. The translation of a human being brings before the mind the picture of the prophet of old, caught up in a whirlwind and borne away in a chariot of fire, but the translation of Edward was not like that of Enoch or Elijah. It was a transference of the body from its original tomb to a magnificent shrine nearby, which was performed with great pomp and the date, October 13th, was introduced as a saint's day in the calendar of the English Church. King Henry III rebuilt the Abbey of Westminster and on October 13, 1269, performed the second translation of this saint by transferring his remains and relics to a shrine of extraordinary magnificence in the Abbey. Besides the stories of miracles that grew out of the Confessor's great reputation for holiness, there were different versions of the circumstances attending his death, some declaring that he was murdered at the instigation of Harold, his successor; others that his wife Elfrida caused his assassination; and a legend went so far as to say that the manner of his death was by crucifixion, head downward, which seems to be the ground for placing the figure as it is on the clog. Other saints' days may be easily recognized on the clog almanac.

Important dates of business or pleasure were also marked. March 25 was Lady Day, indicating not only the annunciation of the Virgin, but the date of leases, etc. May 1 had a bough to represent the festival of "bringing home the May"; and the rake, June 11, symbolized hay harvest; etc. These markings, however, are not alike on all the clogs, some of which are sparing of emblems, the Norwegian and Danish differing from the English.

Only a few of these quaint calendars are still in existence. Specimens are to be seen in the libraries of Oxford and Cambridge Universities, and here and there one is to be found in the possession of a family as an heirloom, much as

we now find an occasional old spinning wheel, or a "horn-book."

An almanac that has had the interest and support of a great many people for nearly thirty years is that of the late Rev. Irl R. Hicks. This is the only almanac known to the writer, of which the primary purpose is to forecast the weather and discuss weather conditions, and without admittedly resorting to astrology, its maker has elaborated a scheme of interpretation of planetary positions and their effect upon climatic conditions on the earth, by which he predicts the weather methodically. He fortifies his predictions by the claim that the interpretations which he makes of stellar and planetary influences exactly conform to experience. He assures us, indeed, that he has the only true combination of theory and fact, and on that he rests his claim to originality and distinction. It is only a matter of time, he declares, when the material that has been slowly and laboriously accumulated under government auspices will convince doubters that his work rests upon truly scientific and indisputable principles. He has had a good many followers ready to accept his *ipse dixit* as the last word in weather predicting.

In No. 1 of the Almanac, that for 1894, the editor gives in detail a very general statement of "Foundation Facts" and principles; then a chapter on the periods and influences of the planets singly. He thinks the existence of Vulcan, the intramercurial planet, a sufficiently well-established fact and the planet an important factor in our weather.

According to this weather prophet storms and weather changes on the earth recur in a cycle of about twenty-three days, which cycle he divides into four parts of five to six days each. Two of these he calls "regular storm periods," and two "reactionary periods." This cycle, with its divisions, forms the basis of the storm calendar. The cycle he also calls a "Vulcan period," and whether Vulcan be a fact or not, he regards the Vulcan cycle as indisputable. The weather

conditions that characterize a regular and also a reactionary period are given in general terms, but "these periods are modified or aggravated according to the impingement or absence of other causes. There are times when phenomena not common to the Vulcan period are found to blend with it, not only prolonging but increasing the Vulcan disturbances." These disturbances are then examined in detail and discussed in connection with each of the planets. Mercury is strong in its influence, but Venus is "put down as the most positive and intense disturber of the whole family of planets." Of course we might expect this from its size and nearness to the earth. The whole weather scheme rests upon a theory of planetary influence, which is so strongly tinged with astrological notions as to be extended to apply to sanitary conditions on the earth, especially to epidemics like cholera, influenza, etc., Saturn being particularly powerful and baneful. The moon, of course, shares in its effect upon the weather, but as to "Moon Signs" and lunar influences upon terrestrial affairs generally, the editor declines to make any positive statement *pro* or *con,* preferring apparently to keep the "open mind" that should characterize the truly scientific investigator. He gives, however, a list of specific effects popularly supposed to be produced by the moon when in each sign of the zodiac. The planetary influences affect the whole earth, but he does not very definitely locate them, except as northern, southern, eastern, or western. Sometimes they are brought within the compass of territory embracing several states of the Union. In this non-committal way he gives forecasts for each month as to storms or fair weather; dry, wet, hot, or cold; tornadoes and earthquakes come in for a large share of attention, earthquakes particularly being a sort of hobby with him. Like the predictions of astrology, his are general, vague or equivocal—storms will prevail with violent atmospheric disturbance; a severe drouth is probable; and so on—but they are seldom definite as to locality, until

after they have occurred *somewhere* and *in some shape*, and then in the almanac for the following year this verification is pointed out and commented on, with "behold, I told you so!" In the predictions for June, 1917, after an eloquent description of "electrical manifestations at such June periods," we read "The 19th, 20th and 21st are days we will name as being dangerous. Possibly not"—which recalls Josh Billings' prediction for Jan. 5th, 1870, mentioned on p. 44.

It is common knowledge, which nobody questions, that so-called hot waves and cold waves, storm periods, the duration of high or low barometer pressure over a stated area, last usually four or five days, and are followed by a mitigation or reversal of those conditions; furthermore, that topographical features of the earth's surface such as the trend of mountains and valleys fix the direction of movement in winds and clouds, so that certain geographical districts have a special relation to other districts as to sequence or alternation of weather conditions; that recent upper air studies are increasing our knowledge of atmospheric conditions; that the great luminary, the sun, is a most potent factor in modifying our climate;—but the manner in which or the extent to which the planets may be concerned, or that they have anything to do with it, is mostly assumption. (For recent views of meteorologists concerning this, see p. 238.)

Hicks' almanac has apparently been a candid endeavor to construct a method of weather forecasting upon meteorological data. Its weakness lies in defective premises which imply broadly that coincidence proves cause and effect; that when two events occur together or when one comes on the heels of the other, one is caused by the other or both are due to a common cause. Like his own weather prediction, it may be so, "possibly not." But it claimed to be *scientific*, and that caught many a reader for whom, today, "Hicks" is as trustworthy as any Prophet in Israel. It became somewhat

of a thorn in the flesh of the government meteorologists. The U. S. Weather Bureau has actually been put on the defensive by the importunity of that nagging individual who "wants to know"; in this instance he wants to know why the Weather Bureau cannot indicate the weather for more than a day or two in advance, when Hicks predicts so assuredly for a whole year. The reply is given in Bulletin No. 35 of the U. S. Weather Bureau, entitled Long Range Weather Forecasts, by Professor E. B. Garriott. It contains a critical examination of the pretension to accuracy in weather prediction by systems of so-called planetary meteorology like that of Hicks and others, with caustic comments upon them. The conclusions reached after tests made by the Weather Bureau are given at the end of the section on "Weather Signs" (infra, p. 237) but the futility of protesting in that way against the almanac forecasts is plain, since the latter keep on appearing at short and regular intervals, with constant reiteration, while the reports of scientific tests or investigations are published but once, and then meet the eyes of few readers—perhaps of none who especially ought to see them.

Medicine is the "eternal camping ground" of the charlatan and the quack, and the purveyors of patent medicines could not overlook the advantages of the almanac in exploiting their wares and especially in putting them before the rural public. These almanacs may not abound today as they did a half century ago, but any one past middle life can call to mind a good many long established almanacs of this class as well as newer ones: Ayer's, with its pills and vegetable compounds; Jayne's, with its pectoral remedies; Morehead's, with its magnetic plaster; Hostetter's, with its stomach bitters; *et id genus omne.* Before the laws of electricity and magnetism were clearly recognized and formulated, the application of these agents was chiefly empirical and it was the quack's delight to proclaim that "electricity is life," that animal magnetism

was the key to vitality, that special magnetic rings, and galvanic belts of his own devising and construction, would eliminate disease and prolong the life of the wearer. His almanac was decorated with a majestic figure of Jove holding aloft bolts of lightning in sheaves; a symbol of the might with which those same galvanic belts would repel the assaults of any foe to health. Here was a field from which he reaped an abundant harvest. In these almanacs the aforementioned anatomical figure surrounded by the creatures representing the constellations of the zodiac was sometimes capped by the legend "I am fearfully and wonderfully made," a statement we would scarcely want to dispute after looking at this picture, even if we had not the Psalmist's word for it.

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THE TRANSMUTATION OF METALS

A place among the classic "Follies of Science" is universally conceded to this subject, but it has run the gauntlet of criticism and ridicule more successfully than any of the others; and as a problem, by simply throwing the responsibility for its solution upon Nature instead of depending on the ingenuity of alchemists, it gives indications of accomplishment today, although in a form altogether different from that sought by the experimenters of old. It is not certain now that lead may not become gold, but it is quite as likely that gold might change into silver or copper. Regarded as an achievement, the Transmutation of Metals and the Philosopher's Stone were virtually the same thing, for the latter was simply a substance by means of which the former was accomplished. The operation was not only chemical in its nature, but was the real basis of chemistry. Accounts of alchemy date from the first century of the Christian era, though tradition carries it back much farther. In its progress it controlled chemical efforts until the middle of the sixteenth century, and survived fully a century and a half longer. As late as the eleventh century, an encyclopaedia by Suidas gives the definition "Chemistry, the artificial preparation of gold and silver." * This specific purpose of chemistry was designated alchemy, while chemistry proper developed along broader lines. Alchemy reached its greatest height between the years 1200 and 1500, when it had come into royal favor and had potent influence with courts; and having become linked with magic and astrology, it aided in disseminating superstition and playing upon human credulity. It was a part of the mysteries of

* *History of Chemistry,* by Ernest von Meyer, translated by George McGowan.

secret societies and gave weirdness to their rituals. It was not confined to one country nor did it make its appeal especially to the uncultured; those nations which, at the time, stood most prominently for the graces and refinements of education were the nations in which alchemy was in highest repute. Within its legitimate scientific scope the most conspicuous figures were the German Albert von Bollstädt (Albertus Magnus), 1193–1280; the Englishman Roger Bacon, 1214–1284; the Provençal (though educated in Spain), Arnold of Villanova, 1235–1312; and the Spaniard Raymuud Lully, 1235–1315.*

The transmutation of metals as conceived by the alchemists differed from the idea we have of it now because of the early notion of the nature of metals. A metal was not only distinguished by its physical properties but was completely determined by them. Gold is yellow, and if a red metal like copper could be made into one that is yellow like brass, it was on that account more nearly gold, and the transmutation of copper into gold was partly effected. If copper was whitened by mercury it was being changed into silver, and so on. Their common idea was that the various metals were simply modifications of one substance. Gold and silver were "noble" metals and more nearly perfect than the others, and if the latter could be so treated as to remove the impurities which they contained they would be converted eventually into gold.

Mercury, discovered about 300 B. C., was a valued factor in most operations of alchemy, and its remarkable elusiveness along with its readiness to amalgamate with other metals gave rise on its part to another of the "Follies," the problem of its fixation. By the eighth century the theory

* Prof. J. M. Stillman in *The Scientific Monthly* for June, 1922, points out that nearly, if not quite all the alchemical literature attributed to every one of these four distinguished scholars is the product of half a century to two centuries later than the authors to whom it is ascribed.

was widely accepted that the metals consisted of sulphur and mercury, although it was not certain that these constituents were identical with sulphur and mercury in their natural state. With the alchemists an element meant a certain principle or quality. Sulphur meant the principle of combustibility (later replaced by the more substantial phlogiston), and mercury the principle of metallic behavior—that which really constituted metallicity, and later came salt, which meant the principle of solubility. A substance would be one or another metal depending upon the extent to which it possessed these various qualities; therefore the effort to make artificial gold was by no means nonsense. "There was *a priori* no reason why a change of lead to gold should be less possible than a change of iron to rust, indeed there is no *a priori* reason against it now." (Enc. Brit., Art. "Element.") The idea that all substances are modifications of one primary or basic substance was advocated in a modernized form during the nineteenth century, and is not yet dead.

Mercury, as obtained in nature or from its sulphide cinnabar, was either liquid, or volatilized by heat. Metals were solid, and whether the mercury of nature was identical with that element in all metals was not certain. It united readily with various metals and as a liquid it was very elusive, and whether it was truly a metal could only be decided by obtaining it in a "fixed" or solid form in which it neither volatilized nor united with other metals. This so-called fixation would probably secure to the philosophers the basic substance of all metals. So the fixation of mercury was a problem of the alchemists which was not solved until 1759, simply because it was not tried by any scholars in latitudes where the temperature went as low as —40° C. and no artificial means was known for obtaining so low a temperature.

Although alchemy is chemistry, it is to be noted that

the alchemists called themselves philosophers. In passing judgment upon them, two things must be kept in mind: one, that many of them were men of large intellectual calibre, and of sincere purpose to explore the mysteries of nature and to accomplish real scientific work, while some were downright frauds, often timeservers or parasites seeking to curry favor with rulers, nobles, or other wealthy patrons; the other, that among the honest ones their work was the effort to bring to perfection that which was imperfect. To accomplish the transmutation so-called "medicines" were to be employed, those of the first and second order being preliminary and partial in altering the properties of the base metals into those of the noble ones, but the transmutation proper could only be effected by the medicine of the third order, which was variously designated as the Philosopher's Stone, the Great Elixir, or the Magisterium (masterpiece). The preparation of the "medicines" was the puzzle. Dr. James Campbell Brown says:

"the best extant definition of the philosopher's stone is probably that contained in Salmon's *Biblotheque des Philosophes Chimiques,* a collection re-edited in the sixteenth century. It is there defined as 'the universal medicine for all imperfect metals, which fixes that which is volatile, purifies that which they have impure, and gives a colour and a lustre more brilliant than Nature.'" *

From the thirteenth century on, for the preparation of the philosopher's stone a *materia prima* was deemed requisite and to obtain this was the hardest task of all; though various alchemists professed to derive it from various raw materials, they jealously guarded the secret of its production. True, they often wrote out formulas for its preparation, but these were expressed in a jargon so mysterious, dark, confused, and often ominous as to be incomprehensible and useless to those who would try to follow

* *History of Chemistry,* p. 177.

them. When the philosopher's stone had been obtained they performed extraordinary things with it, of which this example is quoted from Lully by von Meyer:

"Take of this precious medicine a small piece as large as a bean. Throw it upon a thousand ounces of mercury, and this will be changed into a red powder. Put one ounce of the latter upon one thousand ounces of mercury, which will thereby be transformed into a red powder. Of this, again, one ounce thrown upon a thousand ounces of mercury will convert it entirely into medicine. Throw one ounce of this on a thousand ounces of fresh mercury, and it will likewise turn into medicine. Of this last medicine, throw once more one ounce upon a thousand ounces of mercury, and this will be entirely changed into gold, which is better than gold from the mines." *

Surely a monotonous process, but it shows the importance of the philosopher's stone which, in its turn, can only be got from the *materia prima.* The old books are full of recipes for changing metals, which were for the most part methods of debasing gold or silver into alloys or amalgams. Among books of today the two histories of chemistry which we have cited contain excellent accounts of the alchemists, and that by Dr. James Campbell Brown has one chapter of especial interest upon the symbolism of the alchemists. He tells us that

"the alchemists, by the term elixir, magisterium, medicine, or philosopher's stone, understood a compound which was supposed to possess the power of transmuting the baser metals into gold or silver. . . . As centuries passed away, the alchemists became more and more extravagant in their visions, and added to the original idea of transmutation various other powers, such as making precious stones, curing diseases, prolonging life, and controlling elemental spirits. The philosopher's stone could preserve health, raise the dead, make the old young, turn the coward into a hero, strengthen the memory, and sober the drunkard." †

Nor was Royalty proof against the seductions of alchemy. We have seen that kings rated astrologers highly, and we

* *History of Chemistry,* McGowan's translation, p. 43.

† *History of Chemistry,* p. 185.

can well understand that the Philosopher's Stone was a desideratum, especially to monarchs whose coffers were low.

These delusions seemed to be particularly strong at the close of the sixteenth century, just when the Holy Roman Empire, embracing all of modern Germany, Austria, Hungary, and Bohemia, was upon the verge of the thirty-years war. The Emperor Rudolf II has been censured for neglecting the important affairs of State to dabble in the trivialities of science, when Catholics and Protestants were about to plunge the empire into this sanguinary struggle. In vain his ministers cried "Scotland's a-burning." Because he devoted himself to art and the sciences of the day, especially astrology and alchemy, instead of politics, when this great religious conflagration was kindling, he has been called weak and incompetent. Certainly he was no great success as an emperor, but there is something to his credit in his recognition and support of genius, and he himself thought it his glory rather than his shame to cultivate the sciences and seek to probe their mysteries. Of course he was imposed upon, for it seems as if no one ever goes far on the path of occultism without losing his sense of balance, and pretenders made the most of an opportunity to practice upon this royal votary. But not all his protegés were frauds: Tycho Brahé, disgraced by the Danish Court and exiled from his splendid observatory at Oranienburg, found a refuge at Prague, where the Emperor Rudolf II installed him in a castle especially fitted up for him and his astronomical work; and under the patronage of this same emperor thither came also John Kepler, first as pupil and later as successor to Tycho. It was still an age of superstition from which science had scarcely begun to emerge, and both of these geniuses were imbued with many of the fancies intimately connected with science. They were not indifferent to astrology and supermundane influences; alchemy

did not appear to them unreasonable; and when their patron was an avowed devotee of both these subjects, they at least did not feel called upon to make any vigorous protest against them. If the emperor suffered from astrologomania his affliction was a very common malady. Says the historian Anton Gindely

"Hardly any considerable personage came to him" (Rudolf) "for an audience but he had the messenger's horoscope cast and governed his conduct toward him by the result of that. As a consequence, there was never at Prague a scarcity of astrologers and chemists, whom Rudolf needed for his investigations. Of the former, Tycho Brahé and Kepler were honorable men and gained undying fame in their science, while the latter were adventurers who now boasted of the art of making gold, now promised wonderful feats by sympathetic means." *

As the emperor was generous in his equipment of his astronomers for their work we cannot suppose that he was less liberal towards his alchemists, or that their laboratories lacked furnace or bellows, retort or alembic. He was especially indulgent to the alchemists (*Goldmacher*) Michael Sendivog and John Dee, and to the spiritualist and mind reader Hieronymus Scoto. He gained the reputation of being himself skilled in black art, a fact which is perpetuated by an inscription in the castle at Prague. This declares that "to prove that he transmuted metals by means of a tincture that Sendivog had prepared for him, they still displayed in Vienna in the 18th century, leaden bars, of each one of which, Rudolf had converted one half into gold. Also in Prague was a chair, seated in which, with Scoto as medium, he had had dealings with the devil." †

The alchemists must have realized that gold would depreciate in value if it became abundant, and that was another reason for keeping the process of obtaining the philosopher's stone a profound secret. On the other hand, it has been

* *Rudolf II und Seine Zeit,* Band I, S. 29.

† Allgemeine Biographie: Rudolf II.

thought that "one of the objects which the better class of alchemists had in view was the making of gold to such an extent that it might become quite common, and cease to be sought after by mankind. One alchemical writer says: 'Would to God that all men might become adepts in our art, for then gold, the common idol of mankind, would lose its value and we should prize it only for its scientific teaching.'" (John Phin, *The Seven Follies of Science,* 3d Ed., p. 91.)

In the number and extent of powers ascribed to it the philosopher's stone surpassed the magician's wand, and made the transmutation of metals and the elixir of life identical with itself in the list of "Follies of Science." Its devotees formed secret societies, and its pursuit furnished material for romance as well as for history. A notable instance is Bulwer's *Zanoni.*

In 1850 Charles Mackay wrote (*Popular Delusions*), "In our day, no mention is made in Europe of any new devotees of the science. . . . Alchymy, in Europe, may be said to be wholly exploded."

But it did not stay exploded.

"You cannot unscramble an egg," says the proverb, but something like it occurred in the ensuing half century, for the fragments of that exploded bubble were effectually gathered up and reunited, and the alchemical egg was restored, whole and fertile.

So long as the ultimate nature of matter is unknown, the transmutation of the elements will be an open question. Every new theory in chemistry has broadened its conception of matter and opened new possibilities and none has determined the impossibility of transmutation; they have simply qualified the form which the transmutation may take or the sense in which the term is understood. So, in spite of the chicanery and extravagance into which the al-

chemists fell, the idea never quite died out, though attempts to realize it had to conform to increasing chemical knowledge. The late Dr. H. Carrington Bolton made a list of nearly three hundred titles upon Alchemy published in the nineteenth century, some of them being periodicals that run into the twentieth century.* In an impressive address to the New York Section of The American Chemical Society, Oct. 1, 1897, on The Revival of Alchemy,† Dr. Bolton gives a vivid description of the progress of alchemy during the Middle Ages and subsequently. This address was not on the possibility or the probability, or the plausibility, but on the "revival" of alchemy;—the scrambled egg was unscrambled. While this infusion permeated the veins of chemists in all civilized countries, it reached its greatest virulence in France, where it had culminated in the establishing recently of a university (*L'Université Libre des Hautes Etudes*), under the auspices of the Alchemical Association of France, in collaboration with other societies of a similar kind. The first of its three faculties was "I. Faculty of Hermetic Sciences," its curriculum leading to the degree of "Baccalaureat en Kabala."

ARGENTAURUM:—An interesting phase of alchemy began in 1896 with the announcement by Dr. Stephen H. Emmens, a New York chemist, that he had discovered a method of producing gold from silver, and with three collaborators had formed a syndicate for the development of his process on a commercial scale. The first public announcements of their success in transmutation were made in several New York daily papers. The account reported in the *Journal* Dr. Emmens vouched for as "substantially correct." The announcement excited sufficient general attention to lead the editor of the *Engineering and Mining Journal* of New York

* *A Select Bibliography of Chemistry,* by Henry Carrington Bolton. (Smithsonian Collections.)

† *Science,* December 10, 1897.

to ask Dr. Emmens to state in that periodical what he had accomplished, with so much of detail as he felt willing to make public. The attitude of the editor, at first merely that of doubt, became rather unfriendly, and eventually might be considered hostile. Several letters were exchanged, the correspondence becoming quite sarcastic, and were published in full in the *Engineering and Mining Journal* in several issues of September, 1896. Dr. Emmens declined to make his process known on the ground that such knowledge, instead of being a public benefit, would prove a financial and commercial disaster. It is delightful to see how dearly such exploiters and promoters have the public welfare at heart. Nevertheless he was obliged from time to time to make explanations. He professed to obtain from silver a substance which he regarded the "raw material out of which both gold and silver were constructed by the hand of nature." This substance he called "*Argentaurum.*" He was able to bring this to a denser state, in which it had the appearance and properties of ordinary metallic gold. He denied the propriety of confounding this work with the alchemy of the ancients, in which the philosopher's stone or a suitable "medicine" is applied to a base metal to convert it into a noble one. Argentaurum and the resulting gold were to be viewed as the legitimate consequence of the fact that all the metals are identical in substance, and their different properties depend on the different ways in which the particles of the common substance are arranged. In this he was simply following out the idea of one basic form of all matter. He insisted that his work was not alchemy; that it was in strict conformity to the existing state of chemical science; that the periodic law of the elements plainly indicated an allotropic form of silver or gold, or of a substance intermediate between them; that argentaurum fulfilled this indication: and transmutationists everywhere hailed *argentaurum* as the "missing link." Let-

ters and papers on this and other subjects, which Dr. Emmens wrote about this time, were called by him collectively "Argentaurum Papers," and, as we shall see elsewhere, *infra, The Overturning of Scientific Theories,* p. 97, were in some instances as revolutionary in social and physical science as in chemistry. Concerning the gold from argentaurum Dr. Emmens stated further:

"The metal which we have made from silver answers every test to which the United States Government Assay Office subjects the gold offered to them for sale. It is, therefore, gold to all intents and purposes. This metal made from pure silver by the process discovered by us could be proved to be gold in a court of law. It not only answers every test of the Government mints, but it also has every quality required by the gold of commerce, having the same color, weight, and strength." *

He made a feeble disclaimer against being regarded as an alchemist, but in response to his protest the propagandists of this pseudo-science would have none of it; they recognized in him a kindred spirit, they welcomed him to their ranks, they made him an honorary member of the Alchemical Society, they extended to him everywhere the glad hand of fellowship, and alchemist he was, *willy-nilly.*

The Argentaurum Laboratory began transmuting silver into gold early in 1896, and on April 6, 1897, the U. S. Assay Office in New York reported the following figures of an analysis of an ingot sold to the Government by the syndicate, and purporting to have been produced by their process.

Weight before fusion	7.06	ounces
" after "	7.04	"
Weight of gold	65.80%	
" " silver	26.00%	
Value of gold contained in ingot	95.76	dollars
" " silver " " "	1.11	"
Cost of analysis	1.22	"
Net value paid to syndicate	95.65	"

* *Engineering and Mining Journal,* New York, Sept. 5, 1896.

On page 32 of a work by M. de Vèze, the author says:

"In a letter dated August 27, 1897, Mr. Emmens announced to me that he had just taken to the mint his tenth ingot of gold. . . . A first dividend has already been distributed to the members of the Argentaurum Syndicate and it will be followed by many others." He also extracts from later letters from Dr. Emmens, "We have just deposited our eleventh ingot which brings our total production of Argentaurum Gold to 150.42 ounces (4 kg. 956 g.). The net profit to date is $522.95 or 2,700 fr." *

Throughout the book the author builds upon Dr. Emmens as one of the pillars of their faith. Among the mutations of the doctrine of transmutation, argentaurum seemed one of the most plausible; but, launched at the time of a "silver craze" in the politics of this country, there was inevitable suspicion of an attempt to depreciate gold by an appreciation of silver. This, of course, was strenuously denied. Dr. Emmens made promises of demonstrations at the World's Fair to be held in Paris in 1900, with a great fanfare, but they never materialized. Extraordinary as were the statements about argentaurum it neither excited the interest of the public nor enlisted the support of capitalists, and the whole matter simply dropped out of sight. Its quiet disappearance was as remarkable as its appearance.

But transmutation of the elements does seem to have occurred, and that through no touch of a philosopher's stone. By no Zoroastrian fires or Kabalistic rites, or Rosicrucian ceremonies, but by a process of her own, Nature has performed this wonder—has probably been performing it since time began, and has only now revealed it, and modern chemistry has seen the element helium *grow out of something that was not helium*—a result of the mysterious conduct radioactivity. Not only that, it has discerned such an order of succession in radioactive products as to leave little doubt that transmutations follow one another in a series that

* *La Transmutation des métaux. L'Or alchemique, L'Argentaurum,* par J. Marcus de Vèze, Paris, 1902.

leads to the familiar metal, lead. It seems rather to be expected, however, that substances of lower atomic weight will come from those of higher. Thus uranium might readily originate helium, and if any of the known substances are to be produced artificially they would be more likely to be substances of small atomic weight. The probable production of lithium is an example, but the production of lead would be in contravention of that idea. A similar notion, though formed on different grounds, was held of old: Sir Francis Bacon thought possibly gold might be debased into lead, but it was not reasonable to expect (the) ignoble (metal) lead to produce (the) noble (metal) gold.

The hope of the alchemists is no longer the vision of a dream; but neither is its fulfilment under human control, by which one may produce gold or silver at will. So singularly is the final product of radioactivity (if lead is a final product) associated with the process that this resulting metal, which itself is radioactive, is not identical with common lead, but is designated "radio-lead." Is there not a suspicious similarity between such a term and "alchemical gold," or even the earlier idea that the mercury existent in iron is not identical with mercury in its native state?

Chemical nomenclature now takes account of the fact that an element may exist in more than one atomic form while retaining the same essential nature, the different forms being called "isotopes."

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PERPETUAL MOTION

Visit a workshop—it matters little what shop, or where—talk with the mechanic skilled or unskilled, his name is Legion, and you will find that he has present in his mind or discarded in his garret a device for perpetual motion. You would be likely to make the same discovery if you consulted a clerk in a counting house, a minister in his study, or the president of a bank. Turn to the man of all men in the whole country who is most familiarly associated with the wizardry of invention—perhaps you know his name—and see if he has not at some time been inoculated with this same virus. When it began to work cannot be known but historically this "folly" is not so old as some of the others. While the baffling mathematical problems and the search for their solution date back several thousands of years, authentic records of The Perpetual Motion are probably not more than five hundred or six hundred years old, but of the many mechanical vagaries unquestionably this has been the most absorbing. If, by a machine that would produce perpetual motion, we mean simply a contrivance that will go on indefinitely without human or animal assistance, the problem is not only solvable but is in constant act of being solved. With the ordinary forces of nature any machine may be kept continually in operation. The incessant flow of water over a waterfall is perpetual motion, and needs only a wheel placed under the falling water to communicate power to other machinery. The turbines under Niagara are examples. Alternations of temperature which cause a body to expand and contract will accomplish the same result. "Perpetual Motion" as a mere fact is a commonplace of science if it is not understood to imply a perpetual supply of power from nowhere. The ceaseless flow

of rivers, the incessant tides, the movements of the earth and other heavenly bodies are perpetual motion, sufficient for all human purposes. But these do not express the purpose of the inventors of perpetual motion. Their idea was and is to produce a device which, when set going, would of itself develop power enough to keep it in operation without drawing upon extraneous sources. The effect of gravity, whether helpful or harmful, was always within their purview, but no other physical agency.

The inventions have been of multifarious design, employing about every known principle of mechanics and some that are not known, but they all fall into a few classes. One type, comprising many of the inventions, is some sort of pump which will raise so much water that when it is discharged upon the wheel or other part of the mechanism, it will drive the machine with more than sufficient power to pump up enough water to keep it going.

Another type is a wheel with jointed arms or spokes that hang down from the side of the hub that is rising, but when passing the top, an arm swings out into a horizontal position, and having a weight at the end, it propels the wheel. There are always one or more extended weighted arms on one side of the wheel, to raise the slack pendent arms on the other side. Instead of jointed arms the wheel may have radial tubes containing balls that roll out from the hub to the rim on the side that is descending, and roll in from the rim to the hub on the other side, thus serving the same purpose as the arms with weights at the end. The wheel is overbalanced. A favorite variation is a clock that shall be selfwinding. Where the winding up has been accomplished by utilizing cleverly some of the work of the descending weights, this has been as fallacious as the scheme of pumps. This type of automatic renewal, like many others that began honestly, has been exploited fraudulently to victimize the credulous, by the introduction of

some auxiliary contrivance which is skilfully concealed, and for a while escapes detection. But genuine selfwinding clocks have been constructed, and consequently perpetual motion, in a qualified sense, has been secured, by using other natural agencies. Expansion and contraction of a piece of metal in the clock, properly geared to the winding machinery has served the purpose and so, too, has the varying pressure of the atmosphere. But these, though genuine, are not instances of perpetual motion as originally understood and sought after. *The Mechanics' Magazine* (London, 1823–1872) at first opened its columns freely to the consideration of perpetual motion. No amount of ridicule or criticism could quench the ardor of the perpetual motion enthusiasts —rather, opposition seemed to stimulate it. Disappointments were recounted by the editor and correspondents, and frauds and tricks of all sorts were exposed; never were propagandists more steadily admonished or more vainly. And yet, only the frauds were supported by actual working models; in the sincere attempts, the inventors relied wholly upon drawings and descriptions to establish their contention, with an insistence that the machine would work, and a challenge to the editor and everybody else to prove that it would not work, and to show why it would not. For a long time an impression was general in England that there was an outstanding offer from the Government of a large reward for the successful invention of such a machine, and in spite of the efforts of publishers to correct this error, one inventor after another asks for information how to proceed to get the reward, in case his invention is accepted. In response to such an inquiry, the editor of *The Mechanic's Magazine* for Jan. 29, 1848 says:

"No reward has been offered by government; it has done many foolish things but none so foolish as this. Before our correspondent wastes any more time on his schemes, let him first seat himself on a three legged stool, and try to lift himself by the legs of his

stool. If he succeeds in that, he may go on—the want of government reward notwithstanding."

The mental attitude of present-day seekers after perpetual motion is severely censured by Mr. Dircks, but his strictures are founded altogether on the record. He says:

"A more self-willed, self-satisfied, or self-deluded class of the community, making at the same time pretension to superior knowledge, it would be impossible to imagine. They hope against hope, scorning all opposition with ridiculous vehemence, although centuries have not advanced them one step in the way of progress."

He enumerates the classes of the people high, low, ignorant, educated that have essayed to produce the perpetual motion, and says:

"There is something lamentable, degrading, and almost insane in pursuing the visionary schemes of past ages . . . not a solitary discovery is on record, not one absolutely ingenious scheme projected, or one simple self-motive model accomplished. . . ." *

But when one has made an illusion part of his very existence can he welcome its destruction? Is there a more pitiful being in the world than a man with shattered illusions?

Perpetual Motion inventors are still numerous, and in most cases are plainly cranky; they are obsessed with the infallibility of their scheme which, at the worst, lacks only some trifling change or addition to make it a success and their persistence makes them actual nuisances. They are always "open to conviction" but never can or never will see what is wrong about their device, no matter how plainly it is shown to them. Often their idea is so crude, so crass, that no intelligent mechanic would fail to see its absurdity, but in other instances the invention is diabolically clever, and even if the scientist does appreciate its fault, he has difficulty in pointing it out or explaining it. It might be expected that applications for patenting per-

* *Perpetuum Mobile:—A History of the Search for Self Motive Power from the 13th to the 19th Century.*

petual motion machines would become embarrassing to the government unless the Patent Office adopted some definite policy regarding them. As the impression has prevailed at some times and places that the U. S. Patent Office had decided to reject outright all such applications, the author addressed an inquiry to the Commissioner of Patents as to the attitude of the Office on this subject. The reply was as follows (Jan. 25, 1917):

DEPARTMENT OF THE INTERIOR

UNITED STATES PATENT OFFICE

WASHINGTON

PERPETUAL MOTION:

Replying to your recent letter, you are advised that the Patent Office understands the term "perpetual motion" to mean a mechanical motion creating energy, that is, a machine doing work and operating without the aid of any power other than that which is generated by the machine itself, and which when once started will operate for an indefinite time.

The views of the Office are in accord with those of the scientists who have investigated the subject, and are to the effect that mechanical perpetual motion is a physical impossibility. These views can be rebutted only by the exhibition of a working model. Many persons have filed applications for patent on perpetual motion, but such applications have been rejected as inoperative and opposed to well-known physical laws, and in no instance has the requirement of the Patent Office for a working model ever been complied with.

In view of these facts the Office will not now permit such an application to be filed without a model and this practice has been adopted in order to save applicants the loss of the fees paid with their applications. After an application for patent has been considered by the Examiner the filing fee of $15 cannot be returned.

W. F. WOOLARD,
Chief Clerk.

The failure to submit a working model is doubtless due to the lack of that "trifling" addition, which cannot affect the validity of the idea on which the invention rests, but the applicant cannot risk the danger of being anticipated

by some one else, and therefore cannot afford to wait for the completion of a successful model.

F. Charlesworth, Assistant Examiner in the British Patent Office, says that the earliest British patent for a Perpetual Motion machine was granted on March 9, 1635, the method of action being not described; the next was in 1662, for an overbalanced wheel with weights at the ends of jointed arms. Between 1617 and 1903 over six hundred applications had been made to that Office for Perpetual Motion, all except twenty-five being since 1854. They were of course greatly varied in character but mainly mechanical, their operation depending on various agencies—chiefly gravity, loss of equilibrium, specific gravity of floats and weights in water or other liquids, receptacles inflated with air or other gas under water, compression and subsequent expansion of gases, and surface tension. So confident were some of the applicants, that they considered it necessary to include a brake in their machine, that it might be stopped or restrained from reaching too high speed.* It was not until the latter part of the eighteenth century that physical science reached a state of development that seemed to preclude the possibility of the perpetual motion, and not until the middle of the nineteenth was its inherent impossibility believed to have been assured. This came with the establishment of the doctrine of the conservation of energy, and the degradation of energy, and yet, as just stated, nearly six hundred applications were made to the British Patent Office in the forty-eight years from 1855 to 1903. Not every mechanic is acquainted with the conservation of energy as a principle of science, and of those who are, not all can escape the lurking thought that sources or forms of energy may be in operation that are not yet recognized either as to their extent or their mode of action. Again among those who do recognize and accept this doctrine are some who question

* *Cassier's Magazine,* V, 29, 1905.

the correctness of one or another supposed law of nature. They therefore hope that by dodging such a law, or by the help of some free energy somewhere, they can secure a perpetual motion of a so-called "second kind." It will be remembered that the astonishing revelations of radium and other radioactive substances seemed, at first, to upset the conservation of energy, and Lord Rayleigh invented a device which acted continually under such radiation, while apparently the energy of the source of radiation was undiminished. He was not so hasty as some others, however, who were ready to believe that the doctrine had broken down, and now such perpetual motion is to be regarded as only one of the second kind, which employs natural agencies not differing from solar radiation of light or heat, or even from tidal power in their relation to the problem.

So generally is the impossibility of "The Perpetual Motion" now recognized among scientific men that when a hypothesis leads to perpetual motion as its certain result, that fact is regarded as a proof of error in the hypothesis, like a *reductio ad absurdum* in logic or mathematics.

In an early work (1648) entitled "Mathematicall Magick," by Bishop John Wilkins of Chester, England, its author says:

"The discovery of a 'perpetual motion' hath been attempted by Chymistry. Paracelsus" (d. 1541) "and his followers have bragged that by their separations and extractions they can make a little world which shall have the same perpetual motions with this *Microcosme* with the representation of all Meteors, Thunder, Snow, Rain, the courses of the sea, in its ebbs and flows; and the like. But these miraculous promises would require as great a faith to believe them as a power to perform them.

'At nusquam totos inter qui talia curant
Apparet ullus, qui re miracula tanta
Comprobet. . . .'

And though they often talk of such great matters, yet we can never

see them confirmed by a real experiment.* And then, besides, every particular author in that art hath such a distinct language of his own (all of them being so full of allegories and affected obscurities), that 'tis very hard for any one (unless he be thoroughly versed among them) to find out what they mean, much more to try it."

The procedure by which one can obtain a perpetual motion in a chemical way, for example, is this:

"Mix five ounces of ☿ with an equal weight of ♃; † grind them together with ten ounces of sublimate; dissolve them in a Cellar upon some marble for the space of four days till they become like oyl-olive; distil this with fire of chaff or driving fire, and it will sublime into a dry substance and so, by repeating of these dissolvings and distillings, there will be at length divers small atomes which, being put into a glass that is well luted and kept dry, will have a perpetual motion." (From Dirck's *Perpetuum Mobile,* p. 3.) It is not quite clear how the Chaldeans could associate the planet Mercury with the metal mercury, when that metal was not discovered until more than two hundred years after the Chaldean empire ceased to exist; but this particular connection may be of later date than the others. Chaucer writes of this association in the Canter-

* The letter from the U. S. Patent Office, on page 84 would indicate that Bishop John Wilkins' ground of complaint against perpetual motion inventors had not been removed during the centuries between his time, 1650 and the present.

† The use of planetary symbols for metals was common in early chemistry and, it is said, began with the Chaldean philosophers and was continued by their successors in astronomy and astrology. They associated the heavenly bodies not only with metals, but also with the organs of the human body. The latter they divided into twelve parts corresponding to the twelve signs of the zodiac. They considered the metals to be seven in number, corresponding to the sun, moon, and five planets, with their symbols as follows:

Gold	☉	Sun
Silver	☾	Moon
Mercury	☿	Mercury
Copper	♀	Venus
Iron	♂	Mars
Tin	♃	Jupiter
Lead	♄	Saturn

bury Tales about 1390. In the Canon's Yeoman's Tale, the Yeoman reels off a long string of scientific nomenclature with which he was made acquainted in his service of the Canon, and enumerates the four spirits and the seven bodies thus:

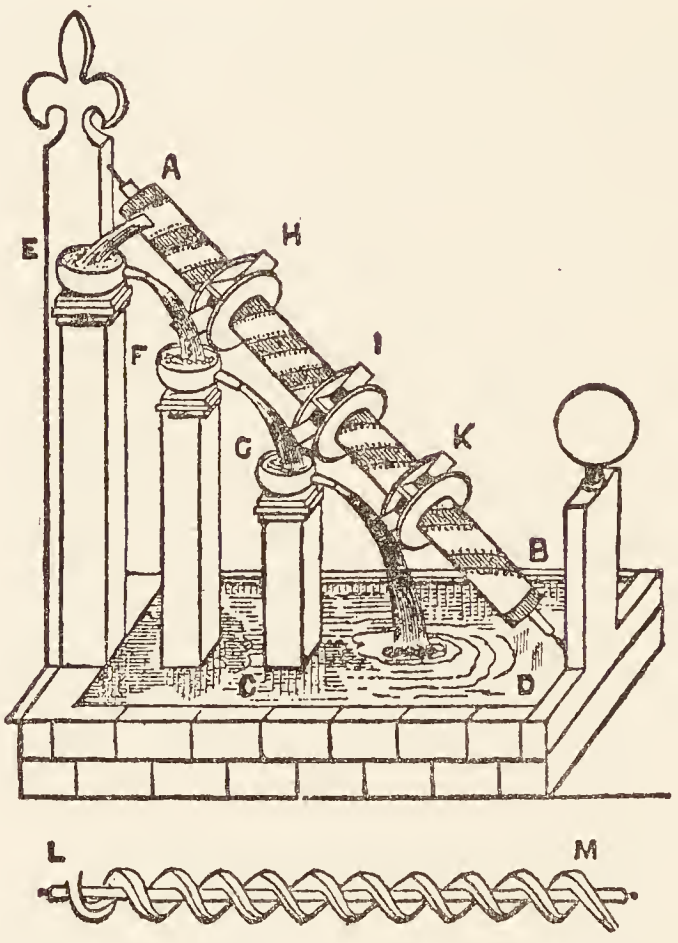
"The foure spirites and the bodies sevene,
By ordre, as ofte I herde my lord hem nevene.
The firste spirit quyk-silver called is,
The seconde orpyment, the thridde, y-wis,
Sal-armonyak, and the ferthe brymstoon,
The bodyes sevene eek, lo, hem heere anoon!
Sol gold is, and Luna silver we threpe,
Mars iren, mercurie quyk-silver we clepe,
Saturnus leed, and Juppiter is tyn,
And Venus coper, by my fader kyn."

He classes the perpetual motion machines as:

"1. Those depending upon chymical extractions;
2. By magnetical virtue;
3. By the natural affection of gravity."

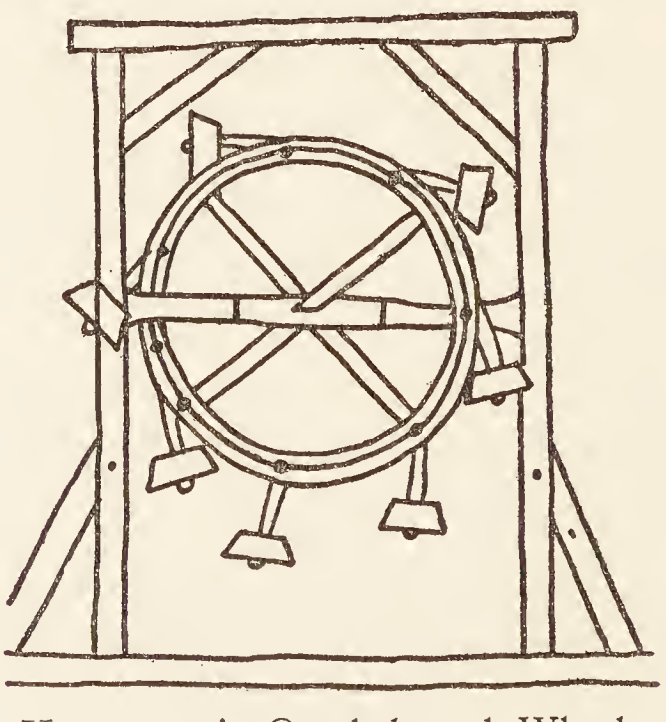
According to Bishop Wilkins, hydraulic machines, kept going by the descent of the liquid which they had raised, were used earlier than the overbalanced wheel, the earliest and apparently most attractive form being that in which water was raised from a cistern by the familiar Screw of Archimedes. The figure illustrates one variant of this type.

When discharged at the top of the screw the water fell upon the vanes of a wheel mounted upon the screw shaft, being caught in a vessel at a lower level and again discharged upon the vanes of another wheel; and as this operation could be again and again repeated, the descending water would more than suffice to keep the machine in operation. This appeared in 1642, but it is difficult to fix the deserts of these inventions chronologically. In a work by Robert Fludd, which appeared in 1618, is described a common water wheel which sets in motion a chain pump by means of a system of toothed wheels, and the pump is supposed to raise the water necessary to keep the wheel going.



Perpetual Motion by Means of the Screw of Archimedes.
(The screw LM is inside the tube AB and its lower end should dip into the water.)

The accompanying figure is a sketch accredited to Vilard de Honnecourt, a Gothic architect of the 13th cen-



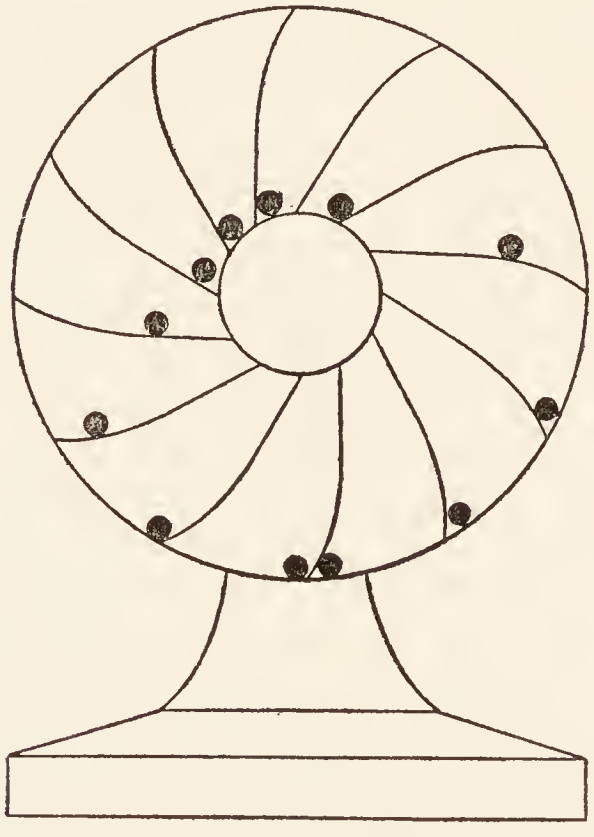
Honnecourt's Overbalanced Wheel.

tury, who gave a description of it, and this seems to be the earliest authentic record of a perpetual motion machine. It represents a wheel with an odd number of mallet-like weights attached to the rim by a hinge at the end of the handle. It is supposed that when set going, the fall of a mallet upon the rim of the wheel gives an impulse to the latter, and as that action in general places more of the mallets on the descending side of the wheel than on the ascending, the motion is continuous! A number of Honnecourt's free hand sketches, including this among others, are in the Paris *École des Chartes.* (F. Ichak, *Das Perpetuum mobile,* pp. 8, 9.) There are, however, allusions indicating that the idea was not absent from the minds of some of the philosophers, even of pre-Christian times. Although the seeds were sown so early, they seemed to germinate and fructify much more rapidly in the Middle Ages, that period of darkness and superstition, from which so much of knowledge did actually emerge in a *renaissance,* but the growth of this particular vagary has been most vigorous in modern times.

Perpetual motion cannot exist with the principle of conservation of energy in any machine that has prejudical resistances such as friction or the inertia of the surrounding air, and the establishing of that principle did much toward quieting the restless spirit, but any apparent contradiction of this principle reawakens the sleeper. Leonardo da Vinci (1452–1519) dallied with the problem.

Of the overbalanced wheel, there are many variations. A famous example of this type was produced by the Marquis of Worcester, about 1648. No picture of the wheel itself is available, though a somewhat circumstantial account of a demonstration with it at the Tower of London is on record, but its character is that shown in the diagram. Many devices for producing perpetual motion have been sub-

mitted to the author for comment. In almost every instance they have been more or less ingenious variants of earlier inventions.

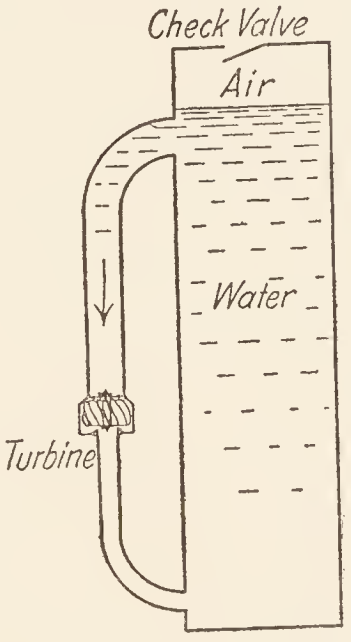


Supposed Form of the Marquis of Worcester's Overbalanced Wheel.

One suggested by Mr. J. S. Hamilton of New York may be taken as an innovation inasmuch as it purports to utilize a modern idea, namely, that of the injector reversed, so as to act as an ejector. Since an injector, by means of a steam jet, will cause a stream of water to enter a boiler against a pressure equal to or greater than that of the steam jet, then, according to this inventor, if a stream of water flowing out of a cistern at a high level have its velocity sufficiently increased, it will re-enter the cistern at a lower point and also do work in its passage external to the cistern.

"Starting the turbine from exterior source, (motor or engine), establishes the vacuum" (below it), says the inventor, "after which the turbine will run alone. The initial pressure will seek the vacuum and perform work *en route*. The water will return by reason

of its increased velocity secured by the nozzling effect of the passage ways inside the turbine. The entrance gates of a water turbine nozzle the water, and since the turbines are radial inward flow, the passage ways in the 'runner' are more narrow near the center where the water leaves it. Provided the water's velocity is increased it will enter, just as the injector has proven times without number."



Bernoulli's Principle Applied to Perpetual Motion.

A discussion of this with its author would inevitably involve a discussion of the injector, to say nothing of what is to keep the turbine in motion if the water, on leaving it, is to have a greater velocity and therefore more energy, than on entering it; but it would not be difficult to show that its successful performance would contradict the conservation of energy. It is needless to say that this machine never reached the stage of a "working model."

With the well-known Principle of Archimedes staring them in the face, inventors could not be expected long to neglect so helpful an idea in their attempts to solve the problem of perpetual motion.

According to this principle, a body immersed in a liquid is said to "lose weight," or weigh less than in air. A force that will lift a stone weighing one hundred pounds in air will lift one of a hundred and fifty pounds in water, and

a block of wood will not only weigh nothing in water but will rise with a lifting effort of its own. As a simple application of this principle, an endless chain passing around an upper wheel in air and a lower one in water has ledges or buckets attached to it carrying balls, and as they descend they enter the water at the foot of the machine and are carried around the lower wheel, and then, either by the apparatus itself or by their own buoyancy, the balls are brought up in a column of water that reaches to the upper wheel, where they are discharged upon the descending side of the chain. The preponderance of weight on this side is the driving force. It is extremely simple (and the believer in it is scarcely less so).

The astonishing thing is the employment of auxiliary pieces like the balls just mentioned, which are light in the water on one side of the chain, and heavy on the other, *i.e.*, the descending side. If the idea were workable at all, the endless belt, a cord, or chain alone would be sufficient to demonstrate the action without the help of balls or weights, for the portion in the column of liquid would be buoyed up and so be lighter than the other portion of the chain, and the movement would go merrily on. It was left to a recent inventor to suggest the machine thus simplified, though he appears to be unaware that the general idea had occurred to others before him. A description and discussion of this attempt at the problem is given by John Phin in his *The Seven Follies of Science.** There is no difficulty in representing it by a drawing, but the hopeful aspirant for a patent is met by that discouraging demand for a "working model," and it seems impossible in practice to get a column of liquid to stand higher in one vessel than in another with which it communicates! Various changes have been rung upon the design, including the buoyant ef-

* *The Seven Follies of Science,* John Phin, New York, 1912.

fort of liquids upon vessels that are inflated in the liquid and deflated outside.

Thus statics, dynamics, hydraulics, pneumatics, all as branches of mechanics, have been called upon in connection with gravity; and by less direct action, heat, light, magnetism and electricity have been invoked in this fruitless endeavor to inveigle Nature into repudiating her own laws.

The Redheffer Fiasco

One American invention played a conspicuous if not very creditable part among perpetual motion machines. This was the invention of Charles Redheffer who exhibited it in Philadelphia in 1812 and 1813. Although it continued in operation apparently as long as its maker desired, it was perhaps not inherently more or less plausible than some others but it became *une cause célèbre*. There were two circumstances connected with it that gave it celebrity, and entitle it to special notice: It created so much of a furore that the legislature of Pennsylvania thought it worth while to appoint a commission of eminent engineers to examine its claims, inquire into their validity and report upon it, and did appoint such a commission. This was a dignity to which such machines rarely attained. The other circumstance was the exceedingly clever way in which the fraudulent character of the machine was twice detected; once, by the eye, trained to observe the niceties of mechanical action; and once, by the ear, skilled to detect any peculiarity in the sound of moving machinery. At an appointed time the commission visited the house in which the machine was exhibited, on the Schuykill near Philadelphia, but arrived there only to find the house locked and the key missing. They did not get the opportunity to examine the machine and could only inspect it through a barred window. They saw a vertical shaft carrying a horizontal disc on which two inclined planes bore weighted cars that descended and

rose at certain points in the rotation of the disc. This action of the planes and cars drove the shaft and disc which, in its turn, propelled further mechanism. The horizontal disc was a spur wheel and the teeth in its edge engaged with those of a smaller wheel and so, ostensibly, drove the rest of the machinery. One of the visiting commissioners, Mr. Nathan Sellers, took with him his young son, Coleman Sellers, who was a mechanical genius, and was keenly interested in the whole affair. Young Sellers saw something that escaped the others; his attention was caught by the appearance of the cogs in these two wheels. They were not much worn, only smoothed a little, but what little effect of rubbing together they did show was *on the wrong side of the cogs!* The faces of the cogs that will show wear depends upon which wheel is driving the other and, in this instance, the small wheel proved to be driving the larger. If the fact is the reverse of this, as it was represented to be, then to the mechanic whose eye detects this discrepancy, such a machine would appear to be running backwards. Although the source of propulsion was not discovered the deception was unmistakable. After returning home the young man told his father what he had discovered; the latter then employed a skilful mechanic to make a small model just like the Redheffer machine, but propelled by a clockwork mechanism concealed in an ornamental post of the framework. This model exactly duplicated the behavior of the larger machine, to the astonishment and mystification of Redheffer himself to whom Sellers showed it. Conscious of his own trickery he was scared by the idea that another had actually achieved what he pretended to do, and proposed to buy out young Sellers, offering him a handsome share in the profits to be derived from the machine. (See Article on the Redheffer Perpetual Motion Machine, by Henry Morton, in the *Journal of the Franklin Institute,* Vol. 139, 1895, p. 246.)

An exposure like this which did not actually reveal the secret of the machine was not sufficient to check the interest of those who wanted to believe in it, and the exhibitions were continued. In 1813, soon after the fiasco in Philadelphia, this same machine or a duplicate of it was placed on exhibition in New York, where it was to meet its second reverse. The sequel is well told by Mr. C. D. Colden in his Life of Robert Fulton.

"One of these perpetual motions," says Mr. Colden, speaking of the Redheffer machine, "commenced its career in this city" (New York), "in eighteen hundred and thirteen. Mr. Fulton was a perfect unbeliever in Redheffer's discovery, and although hundreds were daily paying their dollar to see the wonder, Mr. Fulton could not be prevailed upon for some time to follow the crowd. After a few days, however, he was induced by some of his friends to visit the machine. It was in an isolated house in the suburbs of the city.

"In a very short time after Mr. Fulton had entered the room in which it was exhibited, he exclaimed, 'why, this is a crank motion.' His ear enabled him to distinguish that the machine was moved by a crank, which always gives an unequal power, and therefore an unequal velocity in the course of each revolution; and a nice and practised ear may perceive that the sound is not uniform. If the machine had been kept in motion by what was its ostensible moving power, it must have had an equable rotary motion, and the sound would have been always the same.

"After some little conversation with the showman, Mr. Fulton did not hesitate to declare, that the machine was an imposition, and to tell the gentleman that he was an impostor.

"Notwithstanding the anger and bluster which these charges excited, he assured the company that the thing was a cheat, and that if they would support him in the attempt, he would detect it at the risk of paying any penalty if he failed.

"Having obtained the assent of all who were present, he began by knocking away some very thin little pieces of lath, which appeared to be no part of the machinery, but to go from the frame of the machine to the wall of the room, merely to keep the corner posts of the machine steady.

"It was found that a catgut string was led through one of these laths and the frame of the machine, to the head of the upright shaft

of a principal wheel: that the catgut was conducted through the wall, and along the floors of the second story to a back cockloft, at a distance of a number of yards from the room which contained the machine, and there was found the moving power. This was a poor old wretch, with an immense beard and all the appearance of having suffered a long imprisonment; who, when they broke in upon him, was unconscious of what had happened below, and who, while he was seated on a stool, gnawing a crust, was with one hand turning a crank.

"The proprietor of the perpetual motion soon disappeared. The mob demolished his machine, the destruction of which immediately put a stop to that which had been, for so long a time, and to so much profit, exhibited in Philadelphia!"

Besides the numberless variations in the methods of applying the principles of mechanics to secure a return of more power than is expended on the machine, consciously or unconsciously the principles of themodynamics were invoked by inventors for the same purpose. The fallacy was the same. Only two generalizations are needed to comprise all known principles of heat in connection with work, and these are called the two laws of thermodynamics. They are to the effect that (1) a definite amount of heat has an exact equivalent in a definite amount of mechanical work, and either of these can be transformed into the other; (2) if by any means we cause heat to be transferred from a body to another at a higher temperature, we must in the process supply the system of bodies with energy from some outside source; no self-acting machine will do it of itself.

While the first of these laws is universally and unreservedly accepted, the second has always been a subject of dispute and still is so. The desire to get something for nothing and the belief in the possibility of doing so are too strong to yield to a dictum the demolition of which would seem to assure this possibility. To disprove a law by a process of reasoning is one thing, to violate it by a process of action is another. In theory the law has been controverted repeatedly, and disproved, at least in the opinion

of the controvertists, and if it could only be violated in practice the perpetual motion could be obtained; the "working model" demanded by the Patent Office might be forthcoming.

The Liquefaction of Air and the Hopes It Aroused; Perpetual Motion of the Second Kind

Why should a little matter like the second law of thermodynamics obstruct the path to perpetual motion when we consider what we might achieve if we could be rid of it? The boundless possibilities growing out of the perpetual motion were too fascinating, its unlimited and uncomplaining response to the heightened complexity and increased demands of modern civilization was too satisfying for it to be abandoned, and every advance in science stimulated the hope that a new principle would do away with the limitations imposed by earlier partial and imperfect knowledge.

By 1895 gases had been liquefied by the so-called regenerative method with less difficulty and expense than had before been possible; Mr. Charles E. Tripler of New York had devised apparatus for the liquefaction of air in large quantity, and a popular article concerning Mr. Tripler's laboratory and his remarbable work was published in *McClure's Magazine* for March 1899. This article, written by Mr. Ray Stannard Baker, then of the editoral staff of the magazine, contained some startling statements and one especially which meant the refutation of the second law of thermodynamics and the achievement of the perpetual motion. Mr. Tripler said:

> "I have actually made about ten gallons of liquid air in my liquefier by the use of about three gallons in my engine. There is, therefore, a surplusage of seven gallons that has cost me nothing, and which I can use elsewhere as power."

The very cold liquid air in the boiler of an engine would

be vaporized and have high pressure under the heating effect of the atmosphere, without any other fuel, and the air thus under pressure would drive the engine which, in turn, would compress more air to be liquefied and employed for power purposes. The use of the air for driving the engine constituted no difficulty either in theory or practice, but according to accepted ideas of science, as much work would be required in compressing the air and depriving it of heat as the air could possibly restore in again reaching its normal pressure and temperature. Still, there was Mr. Tripler's statement which he offered to verify in his laboratory. At the invitation of *McClure's Magazine,* through Mr. Baker, two professors, heads of the departments of Physics and Chemistry in a prominent university, visited Mr. Tripler's laboratory to witness such a demonstration. The visit, though made by appointment, proved to be not conveniently timed for Mr. Tripler, and nothing came of it except a brief comment from each of them criticizing Mr. Tripler's claims. This the magazine did not publish, and the exploitation of liquid air and its wonders continued. Those who had declared war to the death on the second law of thermodynamics were elated and exultant.

Mr. Tripler resented calling his invention a scheme for perpetual motion—always insisting that the heat of the atmosphere was a furnace for his liquid air, and consistently refusing to admit that he lost any power in getting the air to a temperature below that of the surrounding bodies, *i.e.,* denying the validity of the second law of thermodynamics. The promises of the liquid air scheme were alluring—bewilderingly so—and its friends were loath to give up the hopes based upon them. Posing as an exemption from a painful but inexorable law, this fallacy lingered for several years and died hard.

Another example of the " second kind " of perpetual motion is found in a pamphlet entitled " Die Perpetuum mobile

Theorie," by Franz Hoffmann, of Saalfeld, Prussia. It was published in Leipzig, in 1912, three years after an international aviation contest at Rheims, in which the Germans were worsted and two years before the outbreak of the great world war.

It is a rather involved scheme which winds up with this naïve bit of patriotic sentiment:

"Any one who cannot understand that, there is no help for,—it will happen with him just as with certain gentlemen who, some ten years ago, had not been able to understand that a body that was essentially heavier than air could nevertheless lift itself free in the air. The consequence of this intellectual debility was that three years ago in Rheims we had to let Messieurs Frenchmen and Americans fly away from us instead of the Germans leading the remaining nations in flying.

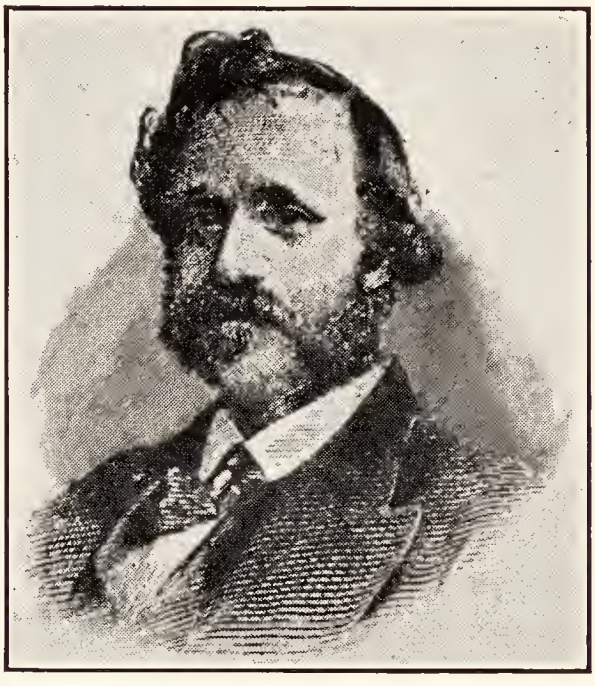
"Perhaps a gracious fate may preserve poor Germany from another Rheims humiliation that will come from the fact that not until other nations arrive in Hamburg or Bremen with their 'perpetual motion" ships, will the German Michael awake from his lethargy."

He implores every reader who still has any regard for Germany's name and honor to do what he can that, at least in respect to perpetual motion, Germany may remain in advance of the other nations!

The Keely Motor

After the search for the perpetual motion was abandoned by true scientists, and the fallacy became too generally recognized to make it a means of coaxing money from the credulous investor, the idea took the no less insidious character of a machine which required a constant moderate supply of power from an outside source, but would return this many times over. This result was to be accomplished by means of special mechanical actions or reactions which were declared to be either wholly new discoveries, or else actions that were not commonly understood. Practically unlimited supplies of power could be produced at little cost.

These special actions were, of course, the inventor's secret, but among them "vibration" was one of the most potent, and twin brother to this was "radiation." A celebrated instance of this phase of the perpetual motion vagary was the Keely Motor. This, while not claiming to be a perpetual



John W. Keely.

motion machine, did purport to furnish motive power with a minimum expenditure of energy upon it. It comes therefore in the class that legitimately succeeded the efforts to secure perpetual motion; but instead of being a sincere attempt to advance mechanical science by a genuine discovery of a new principle or some new application of old principles it was a fraud, although masquerading for a long time under the garb of honesty.. It possessed so many of the characteristics of this kind of foible as to justify a somewhat extended account of it.

The inventor John Worrell Keely was a carpenter, who was born in Philadelphia in 1837 and died there in 1898. He was a good mechanic and a very clever talker, but not a highly educated man. With a claim to have discovered a new force in mechanics which was to work wonders, he

succeeded in inducing a dozen engineers and capitalists to organize a Keely Motor Company in New York in 1872, and to subscribe ten thousand dollars to begin the construction of the motor. He immediately applied his money to the purchase of material and the construction of machinery, and began to attract the attention of the public in 1874 when he gave a demonstration of the motor before a small company of prominent citizens of Philadelphia, November 10th of that year.

Among the expedients resorted to in exploiting a scientific fraud, mystifying lingo is one of the commonest, and in this Mr. Keely was an adept. At this demonstration the machine, or so much of it as was then to be exhibited, was called a "vibratory-generator"; in a later demonstration it was a "hydro-pneumatic-pulsating-vacu-engine" and changes in nomenclature were being rung continually—always vague, delightfully general, and suggesting unlimited possibilities. The inventor's funds began to run low, but his plausibility sufficed to keep him afloat and he so completely deluded his supporters, especially his most ardent one, Mrs. Bloomfield Moore, that he continued to hold their interest, and was kept on his feet financially. By 1890, however, the stockholders had become too weary (or wary) to be put off by evasions or tricks. Mr. Keely declared he was now on the eve of success; he had arrived at that crucial stage, lacking just the one slight adjustment which, in all such cases, proves the insurmountable bar to final achievement. His "generator" had now become a "liberator" which would disintegrate air and release an etheric force of cyclonic strength. One spectator at a demonstration said that a pint of water poured into a cylinder seemed to work great wonders. "The gauge showed a pressure of more than fifty thousand pounds to the square inch. Great ropes were torn apart, iron bars broken in two or twisted out of shape, bullets discharged through twelve inch planks, by a force

which could not be determined. In the glory of his exuberance Keely now declared that with one quart of water, he would be able to send a train of cars from Philadelphia to San Francisco, and that to propel a steamship fromNew York to Liverpool and return would require just about one gallon of the same." (Julius Moritzen, in *The Cosmopolitan* for April 1899.) His technical terms were bewildering, intentionally so; "molecular vibration," "sympathetic equilibrium," "oscillation of the atom," "etheric disintegration," "quadruple negative harmonics," "atomic triplets," came glibly from his lips to confuse or to enthrall his auditors.

At that time one of the greatest steamships in operation, the Teutonic of the White Star line, crossed the Atlantic in six days, driven by engines of 17000 H.P., expending about 2,500,000 H.P.-hours of energy. That is just about the amount of energy now estimated to be liberated if the hydrogen in *a half-pint* of water were converted into helium. Keely was far within bounds!

Public interest in the Keely Motor dates from 1874. From the first, with the use of no agents but air, water, and the machine, its inventor made pretensions and promises that were more extravagant than those of any visionary or faker that preceded him. The claim to produce magical results by means of a thimbleful of water with appropriate juggling was not new, but, as Mr. Benjamin wrote in 1886, "a power-creating machine of no known form or mode of operation, when based on notions upset eighty years ago, is a wonderful thing. To the confusion of the skeptics, the Keely motor is here, that is, not here but to be here three weeks hence. It has been going to be here three weeks hence for twelve years." ("The Persistence of the Keely Motor," by Park Benjamin, *The Forum* for June 1886.) He ascribes the persistence of this delusion to sheer psychological perversity in that portion of the public that hesitates to put any limit to the possibilities of science,

as it understands the term science. The *New Science Review* for April 1895, nine years later, has an article discussing the action of the motor, entitled "The Operation of the Vibratory Circuit," by Mr. Keely himself, that is an almost incredible jumble of terms. He anchored his analysis of nature to a fundamental "trinity." Every force and practically everything else was "triune." For him the sacred number was not seven but three.

The basic idea of Keely's theory was that if one could catch and impose upon matter, by sympathetic vibration, the extremely rapid vibration that characterizes every atom and molecule, then, by the resonance of atoms, he could effect a recombination that would liberate an incalculable amount of energy. At the time of these experiments radioactivity and the highly radioactive substances were not known; radio-telegraphy and radio-telephony had not dawned upon us and yet, how near each other wisdom and folly may sit! Keely's pretensions appear to have anticipated the very phenomena and powers now associated with radioactivity and wireless signaling; and when we consider the discussions and revelations of atomic energy coming as genuine science within the last two or three years, these seem like an Alpine glow of which he had some glimmering, upon inaccessible peaks which he vainly strove to reach; but again, when we recollect that within a week of the close of the year 1920, a Leipsic engineer fooled many savants by fraudulent claim to have discovered a way to "liberate" (Keely's own word) and yet control that same atomic energy, we can see what an easy path to notoriety the charlatan finds along such lines.

It was not until after Keely's death that the fraudulent nature of his scheme was established. It was then brought out by an examination of his laboratory after the motor had been removed, and it was found that the extraordinary performances of his complicated machinery were controlled

from a cellar in which a source of motive power was operated. This source of power was not actually identified but pipes and connections seemed to indicate pretty plainly that it was compressed air, which could be manipulated by the demonstrator in the laboratory. Yet his real secret has never been revealed. The motor was taken to Boston and set up, but it failed to exhibit any "etheric force" when subjected to any vibratory influence, after its removal from the laboratory in Philadelphia. For a period of more than twenty-five years did this remarkable trickster not only keep his chicanery hidden but escaped the discovery that his pretensions really were impostures, and this in the face of experts and others who witnessed tests of his machine. Many an untrained witness was astounded by "ocular" evidence, and to such an one the doubting smile of one who had not "seen" was irritating, to say the least.

Perpetual motion continues to be achieved, but the "working model" does not appear. The machine is set going, soon comes to a stop, and consistently refuses to operate without help, a failure—the souvenir of a delusion—of no more use than the Millerite's ascension robe after the twenty-second of October, 1844.

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THE OVERTURNING OF SCIENTIFIC THEORIES

"For fools rush in where angels fear to tread."
Pope, *Essay on Criticism,* Part III.

Among scientific controversialists are some who, not content with the refutation of a single law, are ambitious to demolish an entire set of principles or laws connecting many physical phenomena as, *e.g.,* the wave theory of light or of sound. Their contention may arise from an idea that the usual theory is insufficient or from an ingenuity in devising some other theory that could replace it; but there are some who seem to have an inborn feeling of revolt against the necessity of complying with any distinct formula; who are as anarchistic as the most rabid political revolutionist. In any case there is a kink in their mental structure. These are not the workers, the patient investigators who are seeking to enlarge the boundaries of knowledge, and who are not deterred from exploring if their path seems to take them beyond known limits, or if the view which they get from exceptional heights reveals new facts that modify previous conceptions; rather, the objectors want to upset the law because it is the law, or else because it stands in the way of some pet notion to which they have committed themselves. Attempts to refute the second law of thermodynamics are described in connection with perpetual motion, and the liquefaction of air. (See pp. 89, 90.)

It is not uncommon for objectors to offer prizes for proving them to be in error, but these prizes are never awarded.

A

Newton's Theory of Gravitation

With the exception, possibly, of the broad doctrine of evolution, no scientific theory has been promulgated in two

hundred years that is so far-reaching in its import, so comprehensive in its scope, and so satisfactory in its application, as the Newtonian theory of gravitation; and none has undergone so great an amount of (supposed) demolishing. Attacks upon this theory have never been lacking from the day it was launched to the recent exposition of Einstein's theory of relativity, one phase of which relates to gravitation. Before considering the attacks it may be well to see just what Newton's position was, and what his theories signified, something which his critics have not always been careful to do; on the contrary, some of them seem not to have read Newton at all. Nor have they always remembered that his theories crystallized out of notions that had gained recognition and were in a cloudy state of solution. Prior to Newton's time the idea was general that all the parts of a body "tended" toward a common point within the body; that all parts of the earth, including bodies upon the earth, tended toward a point (the center) within the earth; that all bodies in the universe tended toward a center which, in the Ptolemaic astronomy, was in the earth; the Copernican theory regarded the sun and planets as a complete (solar) system, whose center was the center of the sun, toward which all bodies of the system tended; this theory was merely one in a series of scientific revolutions for it must not be forgotten that the establishing of the Copernican system demanded the overturning of the Ptolemaic which, in its beginning, had displaced the ideas of cosmogony taught by Aristotle and the early Greek philosophers. The Copernican theory was by no means generally accepted, even after the lapse of a hundred years from its announcement.

Although in this new theory the planets tended toward the sun, they did not go to it; according to Kepler's deductions it seemed that the planets traveled around the sun in elliptical paths, and the whole Copernican scheme of

astronomy called for an explanation of the peculiar relations or interactions of the heavenly bodies, in consequence of which they continued in those orbits, around the sun and among themselves. Here is where Newton's work came in. A writer of the history of physics says

"Long before (Newton) the weight of terrestrial bodies had been explained by the combined action of all parts of the earth, and this action had been extended to the moon, but the conception of gravity as an effort of like substances to unite, still left a sharp distinction between terrestrial gravity even if extended to the moon (which was assumed to be of the same nature as the earth), and a possible force of attraction of the sun for the planets." (Rosenberger, *Geschichte der Physik;* Band I, Theil II, s. 223.)

Newton's theory of gravitation is comprised in his great work *The Principia* (published in 1687), although this work has almost nothing to say of the ultimate nature of gravity. With most of his critics the bogy is attraction. Coming at more than one-third of the distance through the*Principia* Bk. I, Prop. LXIX discusses the absolute force of bodies in a system "*if* any of those bodies '*attract*' all the rest" and the theorem is followed by a scholium containing this explanatory remark: "I here use the word attraction in general for any endeavour, of what kind soever, made by bodies to approach to each other; whether that endeavour arise from the action of the bodies themselves, as tending mutually to or agitating each other by spirits emitted; or whether it arises from the action of the aether or of the air, or of any medium whatsoever, whether corporeal or incorporeal, anyhow impelling bodies placed therein towards each other." From here on the word attraction is used occasionally without further qualification, but always in discussing the consequences that would follow *if* such attraction existed. Newton so continually and persistently used the phrases "force of gravitation," "gravity of bodies,"

"bodies gravitate," etc, that it seems as if he were scrupulously avoiding the term "attraction." *

Newton's critics have usually taken "attract" in its strict sense, or have given it a meaning which they thought it ought to have, and have either missed or ignored the fact that Newton thus explicitly qualified his use of the term, and that he not only did not suppose matter to be endowed with an inherent power to attract in the narrow sense, but disavowed the idea.

The *Principia* is devoted to the investigation of the direction and magnitude of the force that would give to a body a specified motion or specified path, or else to a consideration of the motion or path that would ensue *if* the force were of a specified sort; and it all results in the conclusion that those motions, paths, and forces are such as would follow *if* matter attracted;—or, bodies act *as if* "every particle of matter attracts every other particle with a force that is directly proportional to the masses of the particles, and inversely proportional to the square of the distance between them," and this is the Newtonian law of universal gravitation. Gravitation itself is that tendency of bodies to come together under a force that is determined by the amount of matter in the bodies, called their mass, and not by any quality or condition of that matter, as solid or liquid, hard or soft, hot or cold, magnetized, electrified, moving, or at rest. Prop. V of Bk. III has this Scholium: "*The force which retains the celestial bodies in their orbits has been hitherto called centripetal force; but it being now made plain that it can be no other than a gravitating force, we shall hereafter call it gravity.*"

Newton did not undertake to tell how bodies manage to bring about the phenomena of gravitation. Numerous attempts to do this have been made by others, their ex-

* See the *Bulletin of The Aeronautical Society,* July 10, 1913, "Theories and Phenomena of Gravitation," by Daniel W. Hering.

planation, in most cases, being not in contradiction to the theory as Newton presents it, but in accord with it. The popular story, which is probably a fable like that of George Washington and his hatchet, is to the effect that Newton was seated in his garden at Woolsthorpe, pondering (dozing perhaps), when his attention was caught by an apple as it detached itself from its stem. It fell—*downward*. Bits of paper fluttered uncertainly in the air, smoke and dust ascended, downy feathers floated upward and away, should not the apple do likewise? But no, like an arrow to its mark, the apple came straight to earth. If, instead of falling, it had sailed aloft into the empyrean it would have been astonishing but *not a whit more mysterious* than its fall to the ground—and that is what kept Newton thinking. Of the "Paradoxes" mentioned in the Introduction of this work, pp. 12, 13, at least six attack Newton's ideas of gravitation directly or indirectly. The direct assaults are mostly flighty or incoherent; the indirect are commonly implied in the course of a substitute theory which sometimes takes the form of an attempt to explain the nature of gravitation or the mechanics of it. Some scholars have even made use of the idea of general repulsion instead of attraction. The rambling, ill-digested criticisms are often a part of an extensive plan of their authors to formulate a complete cosmogony which shall account for everything in heaven and earth—and some do not even stop there.

One of the earliest and most celebrated of explanations accepting the Newtonian theory as correct is that of the Swiss mathematician and physicist George Louis LeSage (1728–1803). At the time of Newton and for more than a century after, the corpuscular theory of heat and light prevailed. LeSage endeavored to show that the atomic theory of the universe, traced back to Epicurus as expounded by Lucretius, and still earlier to Democritus, would suffice to account for all physical forces; that ultramundane mi-

nute particles which he called gravity corpuscles, to distinguish them from those of light and heat, streaming through space in all directions would, by impinging upon bodies, produce the phenomena of gravitation to accord with the Newtonian law, the bodies themselves acting as screens or barriers. His memoir, which he entitled "*Lucrèce Newtonien,*" is one of the most remarkable in the history of science, and is of interest, not only for its subject matter but also for the adroitness with which it made its claim to consideration. At the time of its appearance (1782), ideas of physical science that did not directly connect with older philosophy were taboo in the world of scholars, and were dismissed with scant courtesy; so he opens his work thus:

"I propose to show that if the first Epicureans had only had as sound ideas concerning cosmography as some of their contemporaries to whom they neglected to pay attention, and if they had known only a portion of the facts of Geometry that were already of common knowledge, they would, very probably, have discovered without effort, the laws of universal gravitation and its mechanical cause. Laws, of which the formulation and demonstration are the greatest glory of the mightiest genius that has ever existed; and Cause which, after having long constituted the ambition of the greatest physicists, is today the despair of their Successors." *

He did show elaborately that if the motion of the myriad atoms of matter in space were all directed to the center of the earth regarded as a sphere instead of a flat figure, so that the earth were hailed upon by them on all sides, the gravitative action of the earth and moon, as also the tides, could be explained by the impact of the atoms and the mutual screening effect of the earth and the moon; and finally that the gravitation of the entire solar system, or of any system, might, in the same way, be accounted for by assuming that through every point in space streams of atoms pass in all directions.

This early and celebrated explanation of gravitation has

* *Lucrèce Newtonien,* par G. L. LeSage, Berlin, 1784.

been threshed over and modified by various philosophers and physicists, and besides those who have followed this line as the clue to the action of gravity, some have resorted to wave motion, longitudinal as well as transverse, in the ether as a fluid; and others, a stress in the ether as an elastic solid. Electric attraction and repulsion and, later, electrodynamics were made use of. Recently (1917), Professor T. J. J. See, of Mare Island, California, has formulated a theory that commands attention, of electrodynamic waves so acting as to produce a tension in the medium between two bodies and an increase of pressure beyond them. Besides the explanations and theories from English and American scholars, the continent of Europe was prolific in supplying them, and Australia and New Zealand did not fail to furnish their quota.

These all aim to account for the action of gravity as Newton formulated it, and at the same time, some of the electrical explanations give a possibility of accounting for a departure from the Newtonian law on account of the motion of bodies. That contingency appears to be the only qualification of the theory that has yet seemed really necessary, although the objectors to the law do harry its supporters because it indicates an infinite force when two bodies are brought into actual contact, or the distance between them is zero.

We are especially concerned here with efforts to controvert or to displace the Newtonian theory of gravitation, and still more particularly with those of a fantastic character. The acceptance of a theory is always tentative, until it has undergone rigid tests successfully. Newton's theories had to run the gauntlet of objection, close scrutiny, and harsh criticism, especially from his contemporaries and early successors, as do all innovations that do not promise immediate advantage to everybody concerned with them, but so well did his theory of universal gravitation serve that,

besides removing former difficulties in respect to the known bodies of the solar system, the deviation of some of those very bodies from the paths or positions which the theory expected of them led to the discovery of unknown but perturbing bodies, through the application of this theory; bodies which, when discovered, gave further confirmation of it; and yet, this theory might not have risen to the dignity of anything more than a speculation, if the solar system under the Copernican astronomy had not afforded a test for it on a transcendent scale.

Yet splendidly as the sciences of astronomy and physics grew under Newton's theory of gravitation, there has always been an undercurrent of questioning and a threat of reaction. It has such a tone of finality, it is so very general and at the same time so unequivocal, that it cannot but raise the question whether it is flawless.

A hundred years ago it had become so firmly established and was so generally accepted as a basic fact that to dispute it was sacrilege; by the middle of the nineteenth century the law of universal gravitation had become a household word in the vocabulary of physical science and yet, within the last hundred years, and particularly within the last quarter of that period, it has been called upon repeatedly to justify its demand for acceptance.

A physical proof of the law of gravitation that would be undeniable is not possible unless we can test it with bodies whose mass is extremely large or extremely minute, at distances extremely great as well as extremely small, and moving with relative velocities of any value from zero to that of light. If we are satisfied of its correctness for interplanetary distances, we cannot be certain that it holds for the short distances that separate molecules; if it satisfies our tests with small bodies like Cavendish's lead spheres, we have yet to find a way to test it with two bodies like the sun; and because a velocity of a few miles a minute causes

no appreciable departure from the law, that is a very limited speed from which to generalize broadly. More than one supposed law has succumbed to tests made under more rigid conditions than were practicable when the law was announced. We cannot take as a proof of the law of gravitation, however, the fact that it applies to the planets exactly as to their mass as well as to their distance and movement, when the value of the mass that is ascribed to them is obtained in the first place by assuming the law to be true, and computing what mass of a planet would make it conform to that law. Newton's law has been found good within the limits of our ability to test it, and that it fails beyond those limits remains to be shown.

I

In 1897, Stephen H. Emmens, he of the *Argentaurum Papers* mentioned in connection with the transmutation of metals (pp. 66–69), produced a volume of about one hundred and fifty octavo pages entitled "Argentaurum Papers, No. 1. Some Remarks Concerning Gravitation. Addressed to The Smithsonian Institution, The Académie des Sciences, The Royal Society, *and all other learned bodies.*" Mr. Emmens supports his claim to attention by an official connection with numerous engineering and scientific societies, as founder, member, fellow, or what not. In this book he takes exception to Newton's statements, his demonstrations, and his conclusions. His own demonstrations are not convincing; they give the impression of forensic smartness rather than sound reasoning, and keep one continually on the alert to detect some trick. Having exposed Newton's mistakes, he outlines a system of universal physics by postulating seven definitions and four laws, the most of which conform to generally accepted views, and by means of which a simple formula for the force of gravity is obtained,

that provides for the discrepancy in the Newtonian theory, *as regards minute distance.* He adds a protest against the tactics of silence on the part of scholars who ought to meet his arguments.

Although his book is a much more creditable work than most attempts to reach the same goal, many of which are incoherent or scatter-brained, it was virtually still-born.

II

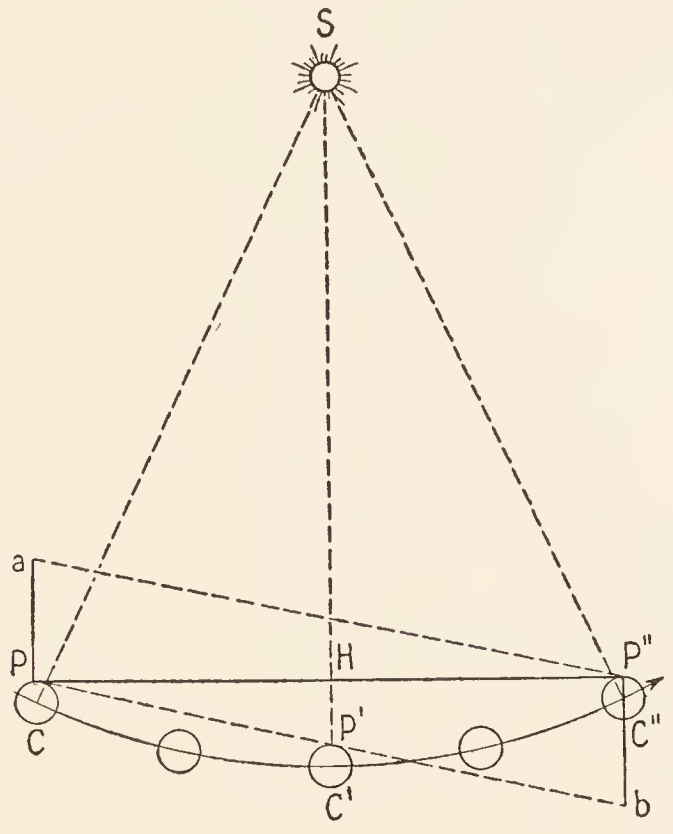
Robert Stevenson, a Scotch engineer (now of New York), of good training and large experience, approaches the subject from a different direction. He discards the idea of gravitation altogether; asserts that the apparent fall of bodies to the earth is not due to attraction or to a force of any kind, centripetal or gravitational; that their falling is not even a fact, but an illusion, just as is the apparent daily movement of the sun from the eastern to the western horizon; and that the phenomena ascribed to gravitation may all be accounted for by the motion of bodies, arising from other causes, and are in accord with a kinetic theory which he has devised for elasticity in matter. Of course that involves contradiction of other generally accepted notions, especially in the science of mechanics.

The following illustration of this paradox in its most elementary form can be easily followed, but in carrying it farther it soon runs into abstruse and difficult mathematics.

Stevenson's Explanation of the Apparent Fall of a Body to the Earth

In the figure, the earth is represented in several positions, as at C, C', C'', moving in its orbit around the sun at approximately eighteen miles per second. At a point P, a body is projected upward with a velocity of, say, thirty-

two feet per second, represented by *Pa*. This upward motion combined with the earth's orbital motion gives the body a resultant motion in the direction *PP″* along which



it travels in a straight line with uniform velocity. As the body and the earth move on, they part company until, at the end of one second, the earth is at *C′* and the body at *H*, a height above the earth equal to *P′H*. One second later the earth has reached *C″* where it has a velocity in the direction *bP″* of thirty-two feet per second, and encounters the body, which *apparently* has ascended from the earth to the height *P′H* in the first second, and *apparently* fallen back to strike the earth at *P″* at the end of the next second, and gravity had nothing to do with it.

There is apt to be some sort of special pleading in attempts to disprove established laws. When Mr. Stevenson shows that a body does not fall to the earth, his demonstration assumes some body to be moving in a circle about a center—in this case the earth moving around the sun—

but ignores the fact (or else denies it) that *a body will not so move* unless it is impelled toward the center by some extraneous action. He repudiates the fact of inertia and the first law of motion; and that is why, as he says, "my old professors, Lord Kelvin and Blackburn, wrote me that I would first have to prove that Newton's first law of motion was a fallacy, and that Galileo and Newton were fools in believing that they were experimenting with falling bodies at the earth's surface." He implies that a change of motion in a body (not the apparently falling body but the earth itself) does not require that a force be impressed upon it. In steering clear of the Scylla of the falling body he encounters the Charybdis of the earth's curvilinear motion in its orbit. Without gravity causing the body to fall to the earth, there is nothing to account for the orbital movement of the earth to meet the apparently falling body.

III

In the eighteen-eighties and nineties a propaganda of "Substantialism" was conducted by A. Wilford Hall, of New York. Rejecting the idea of an ether in space, he considers the force of gravity, like all manifestations of physics, to be of a "substantial" character. He assembles a series of discussions in a large volume entitled *The Problem of Human Life,* and with a keen wit, a caustic pen, and trenchant style, he inveighs bitterly against materialistic philosophers and modern scientists, especially Darwin, Huxley, Haeckel, Tyndall, Helmholtz, and Mayer, and in passing, pays his respects to Newton. He flouts the Newtonian notion of gravitation utterly. In much of his book he essays the poetic and of Newton he says

> "Strange that such a man as Newton,
> When conceiving some connection
> Linking attrahents together
> To account for drawing motion
> Could not think just one step further,

Or conceive that *gravitation*
Might itself be real substance
Of invisible formation,—
Chords of force connecting bodies,
Spun from each corporeal atom,
While their molecules, like bobbins,
Reel incessantly these force-threads,
Till the objects thus united
Should be fully brought in contact.*

With a Hiawatha lilt he goes loping along in trochaic tetrameters, as if nothing were easier than confounding such scientific intellectual pigmies. The magazines *The Scientific Arena* and *The Microcosm,* which he edited as "organs" of his philosophy, contained many contributions from his satellites, who hastened to add their mite of support to his attacks, buzzing like flies, in a minor key and often befogged as to what they were fighting, and why they were fighting it. He reminds one of the preacher who began his sermon with the statement "Saint Paul remarks, and I partly agree with him," for he is quite of the opinion, with Newton, that the gravitative force between two particles varies inversely as the square of the distance between them, but takes sharp exception to the statement that the action upon a body outside of a sphere is the same as if the mass of the sphere were concentrated in a single particle at its center, and the distance between the bodies were to be accounted as the distance from the center of the sphere; and apart from his conception of the nature of gravity, his dissent from the Newtonian law hinges entirely upon this. His labored effort to demonstrate the truth of his idea shows an inability to understand either the mechanics or the mathematics of the problem and his disproof of the law continually exhibits a misconception or a misstatement of Newton, and his would-be corrections of the great philosopher are accordingly worthless.

* *The Problem of Human Life,* p. 68, 2d ed., 1877. In later editions, the portions in poetic form were recast in prose.

IV

A disputant who had devised various inventions, and had submitted to various governments submarine and aeronautical projects that he considered important, endeavored in 1898 to enlist the interest of the author in a disproof of Newton's theories, both of light and gravitation. He called his paper "The *new revised edition* Criticism on Gravitation." A few extracts from the prologue, as it might be termed, read as follows:

"The light's attributes the warmth's electromagnetism will to my confidence be found as the motor of the vital activity of the Universe.

Criticism of the 'power of the gravitation' as the motor of the vital activity, in the scientific acknowledgement as accepted up to the day.

"When Isaac Newton a universal genius of the scientific cognition, founded through his philosophical, mathematical doctrines the spiritual course of the astrophysical disciplines *to all future days,* but at the early days of knowledge, the light and its attributes in scientific darkness—when gravitation was substituted as the motor of the vital activity, a praise of his days—still more as Newton himself at later days, found it problematical.—(Prefais 2nd Ed. of his Optic).

"But the retain of the gravitation of our days, in spite of the advancements of the cognition of all dominions of the vital actuality, to be considert as an reproch of dogmatical remaining of the-Exact-Knowledge, as a loss of the leadership-elaboration of unlimided fields:—"

Then the core of his thesis:

"The gravity can only be accepted a passive attributes of the matter.

"When in the contrary the attraction derived of the adhesivity in the sentenced supposition *as an active motor* will *be found an imagination.*

"The adhesivity will be found associated with the cohesivity, an affinitation—singularity—and *equal* of the pulsation, assimilation, molecularisation *and also the rotation*—but not as the *cause* of the vital activity—*only the consequence*—of the spiritual singular and of all probability, *the light's attributes, the warmth's electromagnetism will be found as the motor of the vital activity*—the consequence of organical perfection."

Signed,

Now queer jumble as it is, that is not really as bad as it looks, and not nearly as bad as it sounds. Its author had very imperfect command of English, and could express himself in that language only with difficulty. His vernacular was German, and his statement bristles with German idioms. Of the forty-four "the's" in the portion quoted, twenty-one are superfluous in English, though quite admissible in German. The ideas in the paper are obscure, but by heeding its idiomatic form of expression it could be translated into fairly lucid English.

In an interview at the request of Mr. —, between him and the author of this book, the latter demurred to Mr. —'s strictures upon Newton's theory of attraction, and on assuring him that Newton had not said that one body actually "attracted" another, he became indignant, and warmly declared that the author had "not the slightest understanding of the fundamental principles of mechanics—let alone gravity!" The interview was not particularly profitable to either party.

V

Tilting in this tournament comes a knight of the laboratory and the machine shop, Benny Bernstein, who is still more vigorous, not to say violent, in expression; a clever mechanic and an exceedingly ingenious inventor, with numerous useful devices to his credit. In an advertising circular he declares himself ready to maintain against all comers the thesis that "Planetary Motion is oscillation by resistance, and creates a positive or automatic, continuous, complete curve motion against resistance that is a corruptaction or motion, therefore everything on planets acts and moves corruptly, viz, dinamic and hydrastatic." Dispute it who dares, deny it who will, understand it who can! We need consider here only his fulminations against Newton and gravity; and first, he may most properly speak for

himself. In a circular (issued 1895), announcing a "Fourth and last letter to Smithsonian Institution, to British Association and Mr. Robert Stevenson," he jeers at Kepler for holding the idea that the moon would draw the waters of the earth to it if the earth ceased to attract them, and adds

"Isaac Newton, the greatest Scientific Humbug, crowned this great falsity by discovering its connection, viz. 'An invisible point in the centre of dead matter exerts an attractive stress on all the rest of the Universe, directly proportional to the multiplication of the masses,' which means that five masses multiplied by five masses is twenty-five masses, and the force of attraction increases in that ratio. Impossible and nonsense."

In reply to a somewhat derogatory statement in a Glasgow journal he says:

"I do not intend to substitute Sir Isaac Newton's theory (central attraction) with a theory. I merely say a fact" (stating a proposition of balanced or unbalanced mechanical action), "and whoever does not want to believe it does not need to."

But he immediately adds

"*My theory* is: The universal vacuum (a black flexible fluid or pressure) displaced through a revolving globe of weight, area and dimension forms into striking funnel-shaped outward (curved) currents from all around the globe thereby; naturally the rings (or curves) the nearer to the revolving globe the smaller and stronger they are, and the further away from the revolving globe the larger and weaker they become in the universal vacuum, and therefore it must follow that a bulk thrown into such forms the heavier it is the deeper and further it must fall into the focus until it strikes the proportionate extending and expanding resistance of the focus in the universal vacuum as to its own proportionate (extending, expanding and the falling weight and thereby an equalized power a zero for the zero) for the resistance it produced and the local equilibrium of the bulk as to its weight, area and dimension must find itself then, even to a pound—and this is reciprocal power."

What can he possibly mean?

It may all be clear to its author but it certainly needs an interpreter for ordinary comprehension.

VI

In the prospectuses of the fourth and fifth "Paradoxes" mentioned in the Introduction (p. 12), Solomon J. Silberstein of New York declares that

> "The planetary motions and of the falling bodies are not due to the law of 'gravitation' which nature does not know. . . . The same is the case with the law of 'inertia' which nature does not know.
>
> "The fundamental law in natural philosophy is the law of gravitation, discovered by Sir Isaac Newton, about two centuries ago, ... I am bold enough to assert, that there never was such a force as the force of attraction; that all the laws deducted from this law of gravitation are utterly without foundation, etc."

Our principal excuse for presenting these extracts from Mr. Silberstein's papers is the fact that the distinguished Professors James and Royce, of Harvard University, gave his work a quasi-endorsement. The list of objections might be much extended but these examples show their general character.

The Newtonian law has been assailed upon every point in its statement. We see Benny Bernstein fuming over the idea that the combined effect of two masses is to be measured by the product of the masses instead of their sum—that the gravitation of two masses of five pounds could possibly be twenty-five pounds instead of ten pounds; Dr. Emmens takes exception to the idea of the inverse square of the distance, since, with two bodies in contact, at the point of contact there is no distance between the particles, and the force uniting those particles would be infinite—disregarding the fact that when carried to such an extreme of mathematical definiteness, the matter that would be mathematically at zero distance would also be nothing in amount; Mr. Stevenson denies the fact of gravitative action at all.

As individual protests these would not go very far, but they are merely examples of *types* of objection, each of

which types has its advocates, and the objections are varied and voluminous. In manner some of the disputants are suave, silky, penetrating; some are fussy, boisterous, and dogmatic; still others are polemic, delighting in argument for argument's sake and enjoying the thrust and parry of such fencing whenever they can nag any one into taking up the foils with them.

> The Scotchman Newton's error shows
> And wields his broad claymore;
> The Teuton's heavy hammer-blows
> Reveal the wrath of Thor;
> Columbia's knights with lighter touch
> Employ the keen rapier,
> And Benny Bernstein "beats the Dutch"
> To make confusion clear.

Or, as one of his contemporaries says of the last named challenger,

> Not his the rôle of Ivanhoe
> With courtly grace to joust,
> Or, granting favor to his foe,
> With sword and lance to thrust;
> Resembling rather Front de Boeuf,
> In battle axe his trust,
> He charges madly down the lists
> And shouts "Pike's Peak or bust!"

What, then, is the net result of the assaults upon this stronghold of modern science? It has not yet capitulated; the citadel has not fallen; the walls have not been breached; at most only the outer barriers have been jostled. Like any and every scientific hypothesis, this of gravitation may some day be superseded, but whether the law is to stand or fall, whether it shall be modified, and if so in what way and to what extent, will be determined by the additions that shall be made to our knowledge, not only of the action of bodies toward one another directly, but the effect of conditions of every sort which may influence them indirectly. Within

a very few years past, ideas have been injected into our former conception of atoms, which call for the revision of either the law of gravitation or the statement that the mass of a body is invariable—at any rate in the case of very small particles moving with great velocity. We have supposed that the mass meant the quantity of matter, and that that would not be different whether the body was at rest or in motion, was in the light or in the dark, was magnetized or electrified or heated or cooled. But we have had no means of deciding whether one body has greater mass than another of a different kind, or has more itself at one time than at another, except by seeing whether the same force affects the motion of one more than another. With bodies of appreciable size and moving with moderate speeds, the law of masses holds good, and the state of motion makes no perceptible difference.

Now it is found that electrons, those ultra-minute corpuscles, small even as compared with the atom, when flowing in streams through a field of, say, magnetic force, are swayed by such force or diverted in their path. This deviation varies if the velocity of the electron is varied, and when the principles that are involved are worked out, this is found to signify that in relation to the direction in which the electron is moving and to the electromagnetic force, the mass increases with the velocity; or the mass ascribed to the electron when at rest must have a quantity added to it to represent the total mass when in motion. The former is sometimes called the mechanical mass and the latter the electric or the electromagnetic mass. This increase of mass is not appreciable at velocities less than one tenth of the velocity of light, and even when its velocity is ninety-nine hundredths of that of light the total value of the mass is only about ten times as great as when the particle is at rest, but with a velocity equal to that of light it becomes infinite.

If, now, as some physicists think, matter is wholly electrical in its nature, this would mean, in our old mechanics, that the mass to be ascribed to a body is different when at rest from that when in motion, and if the mass is different so would be the gravitative effect of other bodies upon it; either that, or we must think that the mass is not different but that the effect of a given force upon it varies with its velocity, which controverts Newton's Laws of Motion. In the present state of science, phenomena of radioactivity seem to support the idea of variability of the mass, if we are to judge of the mass by the effect of a given force. Even so, it must be kept in mind that the most exacting means to detect the variations spoken of give no indications of varying mass in particles or bodies whose velocity is not comparable to that of light, say at least one-tenth as great; a speed many times transcending that of the swiftest body of which we have any knowledge except those extremely minute particles in the corpuscular structure of matter itself—far smaller than the atom.

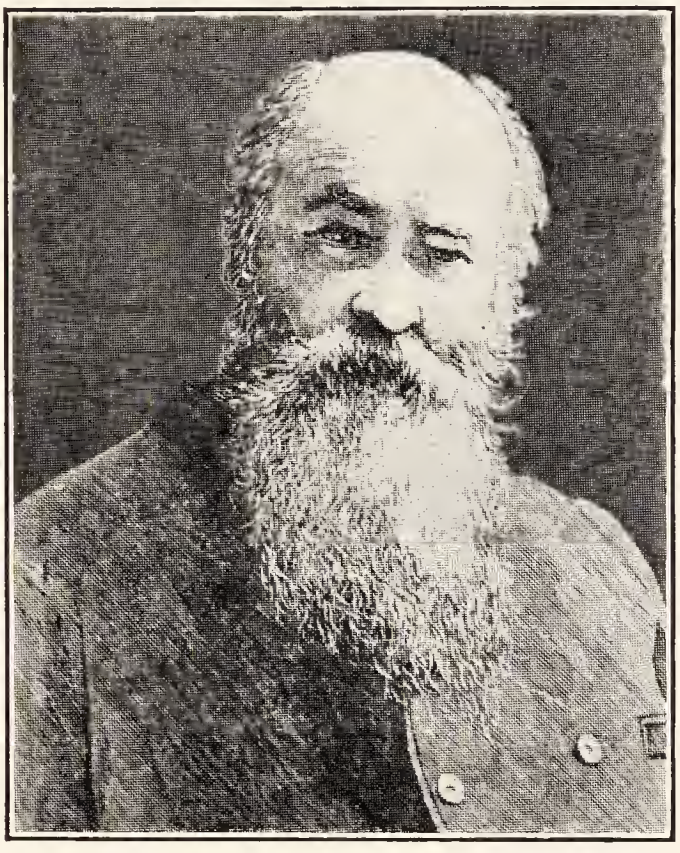
B

The Wave Theory of Sound

I

From 1877, for more than a decade a lively attack against the wave theory of sound was maintained by A. Wilford Hall of New York, whom we have mentioned among the assailants of gravitation, writing at first over the pseudonym "Wilford." Darwinism was exciting theologians of the old school, Haeckel was most disturbing to philosophers both natural and moral, and physicists had gone daft over various wave theories. Dr. Hall's primary object was to establish Substantialism, a philosophic doctrine that was a reversion to the earlier corpusclar theories of the so-called "imponderables" with modifications; his especial purpose

being to show that life processes and life itself are "substantial" but not material in their nature. The scheme was an ambitious one and was pushed with vigor and with



A. Wilford Hall.

large success. As it bore directly upon various branches of physical science we give several paragraphs of the creed.

The Substantial Philosophy teaches that everything in the universe, visible or invisible, tangible or intangible, corporeal or incorporeal, of which the mind can form a positive concept, is *substance or entity,* in some form or degree of grossness or attenuation.

It teaches that the substances of the universe, as above expressed, are naturally and rationally divisible into two main departments, namely, *material* and *immaterial,* which means nearly the same thing as *corporeal* and *incorporeal;* and that while all matter is substance or *substantial,* it by no means follows that all *substance* is *matter* or *material.* The term *matter,* as thus viewed, only embraces a small portion of the substance of the universe, namely, those substances which are ponderable or otherwise susceptible of chemical or mechanical test, or such as are absolutely limited by material conditions.

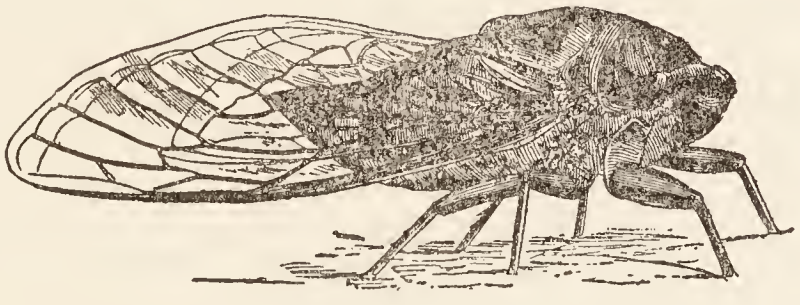
Substance in its immaterial classification includes every *force* of nature or in nature, physical, vital, mental or spiritual, and includes every form of energy which in any way can produce a manifestation or motion of a sensuous body. Hence the physical forces which manifest themselves to our sensuous observation, such as gravity, light, heat, sound, electricity magnetism, etc., are as really substantial or entitative as the air we breathe, the water we drink, or the food that we eat. (*The Scientific Arena,* June, 1886.)

The propaganda exerted a wide influence and was welcomed by thousands of people who acclaimed the advent of a champion against a group of scientists who, just at that time, were promulgating ideas that seemed to them pernicious and subversive of orthodox religious views. The task of its founder would be easier if he could show that the accepted wave theories of science were erroneous, and the wave theory of sound, which was the oldest and had seemed the plainest and least open to objection, he chose for his especial attention, as being at the same time most vulnerable. As it had been accepted with less hesitation than other wave theories, its overthrow would contribute more to the erection of "substantialism." As organs of his propaganda he edited the monthly magazine *The Microcosm* (1881–1892), and *The Scientific Arena* (1886–1888), to both of which he was himself the most prolific contributor.

He conceded that the "forces" (including in that term not only sound, light, gravitation, electricity, etc., but also the agencies causing their manifestation) were themselves set in action by a vibration or tremor of the body from which they proceeded, but this setting into action he called "liberating" not generating the force; and the immaterial substance liberated was not subject to the same limitations as material substances.

As a point of departure from which he proceeded to develop his arguments against the wave theory of sound, he fixed upon the shrill, strident noise made by the locust. This sound could be heard in favorable weather at a distance of

a mile or more and, as he put the matter, in the wave theory the sphere of air a mile in radius around the locust, a mass of millions of tons, was kept in a state of agitation by this insect—an idea too preposterous to be entertained by any sane person. His discussions repeatedly recur to this. The "stridulation" of that locust was kept up for twelve years, and resounded through ten volumes of *The Microcosm,* two volumes of *The Scientific Arena,* and several hundred pages of *The Problem of Human Life.* The innocent insect was an oriflamme, a beacon that rallied all the forces of substantialism to the support of that doctrine.



The Locust.

With the wilful blindness of "those who won't see," Wilford persists in the idea that to effect the necessary compression of air in the spread of sound waves throughout the four cubic miles surrounding the stridulating locust, the puny insect must exert a mechanical force of millions of tons. When it is pointed out that a pebble, dropped in a pond, initiates a wave which travels in an ever-widening circle of rising and falling water until it reaches the shore, although the pebble sank and ceased its action immediately, he triumphantly explains the continued wave movement by the continued action of gravity; but he fails to perceive that the property of elasticity in a transmitting medium performs a similar function with a sound wave. Nor is he at all staggered by the wonderful demand that is made upon the same long-suffering insect by the "substantial" theory, to supply the immaterial substance that must per-

meate these four cubic miles of air, that it may be perceived at every point within that space.

He offers a crucial argument to demolish the wave theory, by which his whole contention shall stand or fall. In this he carries his locust proof to the extreme. He assumes the entire four cubic miles to be divided into cells or chambers of a cubic quarter inch each, that space being allotted to the presence and action of one tympanic diaphragm or membrane which, according to the wave theory, is pushed "once in and once out" with every complete vibration or wave. With the smallest allowable weight, there are 16,000 such membranes to a pound, and yet, the enormous number of them so spaced in the great sphere of a mile radius would amount to *two thousand million tons* of tympanic membrane which this trifling insect, according to the wave theory of sound, is capable of throwing into rapid vibratory motion by the mechanical operation of moving its legs!

But lest this reasoning and calculation may be too abstruse, he simplifies it. He supposes the area of a plain, extending for a mile in all directions around the locust, to be occupied by men as closely as they could stand, say 8,000 on a half acre, every one of whom would hear the strident sound. There would be *five thousand pounds of* tympanic membranes oscillated or bent "once in and once out" 440 times a second while the stridulation continued. He considers his argument invincible, his calculation based on correct mathematical and mechanical principles, and says

"Unless Professors Tyndall, Helmholtz and Mayer are prepared to accept the result, and believe that an insect by the simple movement of its legs in rasping the nervures of its wings is capable of shaking *two thousand million tons* of physical matter, as heavy and as difficult to shake as that much lead, they must of necessity abide the only logical consequence, and abandon the wave theory as an unspeakable scientific fallacy!" *

* *The Problem of Human Life,* Second Edition, p. 178.

And lo, the boot is on the other foot! It is the accepted theory that is the "scientific vagary."

Much of his objection is old and is easily met by a correct appreciation of the action of an elastic medium, the entire value of the substantial theory depending not upon whether the wave theory accounts for sound phenomena, but whether there is any such thing as a sound wave—a thing which Wilford characterizes as pure assumption.

Wilford's greatest grievance seemed to be his inability to provoke a response from any of the distinguished scientists against whom he leveled his guns, though he used his utmost endeavors to draw their fire. Physicists commented on his statements and sometimes criticized them, but steadfastly and uniformly avoided wrangling with him. At the time when this propaganda was in full swing, teachers of evolution were making that doctrine peculiarly obnoxious to preachers of revealed religion, and many of these latter who, for their lives, could not tell a sound wave from a papal bull hailed with pleasure the advent of an ally who was ready not only to do battle for their cause, but who carried the war into the enemy's camp and fought him on his own ground. The discussion as conducted by Wilford, however, was at times quibbling, *ex parte,* and abusive. Dr. Hall displayed a keen relish for the fray of controversy. He was at once pugnacious and credulous. He discerned and combated errors in the Newtonian theory of gravitation (as he supposed), but was easily duped by the Keely motor when he visited the inventor's laboratory and witnessed (?) the astounding exhibitions of the mysterious force which the motor *released.*

II

Wilford was the Elijah of a doctrine in philosophy, and the Elisha upon whom his mantle fell continued the war against the wave theory of sound.

About twelve years ago, Joseph Battell of Middlebury,

Vermont, published a large work in three volumes entitled "Ellen, Or Whisperings Of an Old Pine," in which, in a form much like the "Dialogues" of earlier philosophers, he embodied an elaborate set of views and opinions on phenomena of nature. His work is wholly independent of Wilford's long sustained effort, and yet is in a high degree a repetition of it. The author recast a good deal of "Ellen" and issued it in separate form in a work restricted to the theory of sound. Like Wilford, he utterly rejects the wave theory and resumes the corpuscular theory for all manifestations of physical phenomena, but hardly takes the trouble to discriminate between material and immaterial substance. Like many other propagandists of revolutionary doctrines, Mr. Battell offers large prizes for the disproof of these which he maintains. Heat, light, magnetism, etc., he says, are all matter and are made to be what they are and to do what they do by the way in which matter is mixed in their composition. It is always "shock or disturbance" that causes sound or light *in bodies,* and at the same time makes the bodies emit sound or light.

Instead of vibration making sound it is sound that makes vibration. Sound never vibrates, it makes a straight course unless impeded; the sound made by shock in a tuning fork is impeded in its flow in the metal, is unable readily to get out, therefore, as in the case of echoes, it is constantly thrown from side to side, thus producing the vibration. After alluding to the revival of the corpuscular theory of light, the author of *The New Physics* says

"The corpuscular theory of sound must soon follow, when at last nature's great system of creation, in which every material thing is made through a mixture of matter, will be accepted in its entirety." *

His theory works out beautifully in telegraphy which is an example of corpuscular flow of electricity in the wire,

* *The New Physics. Sound,* p. 15.

of magnetism in the electromagnets, and of sound from the sounder. The overwhelming character of the new physics, so far as sound is concerned, is summed up in a very comprehensive assertion:

"There is not a single phenomenon of Sound that can be explained by the undulatory theory. On the other hand there is no known phenomenon of Sound that cannot be intelligently and fully explained by the corpuscular theory." (*The New Physics,* p. 33.)

Rather a cold douche for enthusiasts who, like Sedley Taylor, thought of Helmholtz's geat work on the Sensations of Tone (*Tonempfindungen*), that "it does for Acoustics what the *Principia* of Newton did for Astronomy." (*Sound and Music,* Pref., p. III.)

In science the question in regard to an accepted theory is not so much whether it is absolutely correct, as how long it will fit known phenomena better than any other one, and that depends upon the progress of scientific discovery. So long as there are more ways than one to account for an occurrence there will be disputes as to which is the right way. The evidences of the rotundity of the earth are not convincing to everybody and there still appear, occasionally, objectors who are prepared to explain away the proofs of it. The Justices of the United States Supreme Court are seldom unanimous in their decisions, and juries often fail to agree though all the jurors have the same evidence to pass upon.

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DIVINATION

Attempts to connect schemes of divination with physical science have not had much success. The practice of ancient soothsayers of divining by reference to the flight of birds or the entrails of animals, and the incantations of witches and the like uncanny exhibitions, were so obviously frauds or else superstitious mummery that they cannot be associated even remotely with science. In so far as divination rests upon laws of science it simply expresses the sequence of events that accords with the laws, so that acquaintance with the science takes away from the predictions any prophetic character and does away with the need of the prophet. Such, for instance, would be the foretelling of an eclipse predetermined from a knowledge of astronomy. The power thus to forecast the eclipse had nothing supernatural about it to Columbus, but to the savages whom he wished to influence it was most impressive. Some systems of divination embrace clear rules for interpreting natural occurrences and then, by associating natural phenomena directly with human experience, the apostles of these systems claim a scientific character for them. A system based upon astronomical phenomena and the position and movement of the heavenly bodies may reveal terrestrial fortunes of every sort, whether of men or animals, of nations, or of the world itself. That is Astrology. If it depends upon the markings of an individual as, for example, a hand or a face, the system based upon such marking gives character reading and forecasting for that individual only, and we have Chiromancy or Palmistry, and Physiognomy. Divining from the conformation of the skull is phrenology. All these schemes are highly refined, and the interpretations are made according to rules that express a definite, constant relation between

the signs and the things they indicate; and whether such relation really exists or is only assumed, the scheme is very systematic and its practice is scientific, but instead of building the scheme upon relations known to be true, so many of the relations have been reasoned out to fit the scheme, or else are assumptions pure and simple, that scholars versed in the sciences upon which the systems profess to rest generally reject them, as being at best *pseudo-scientific*.

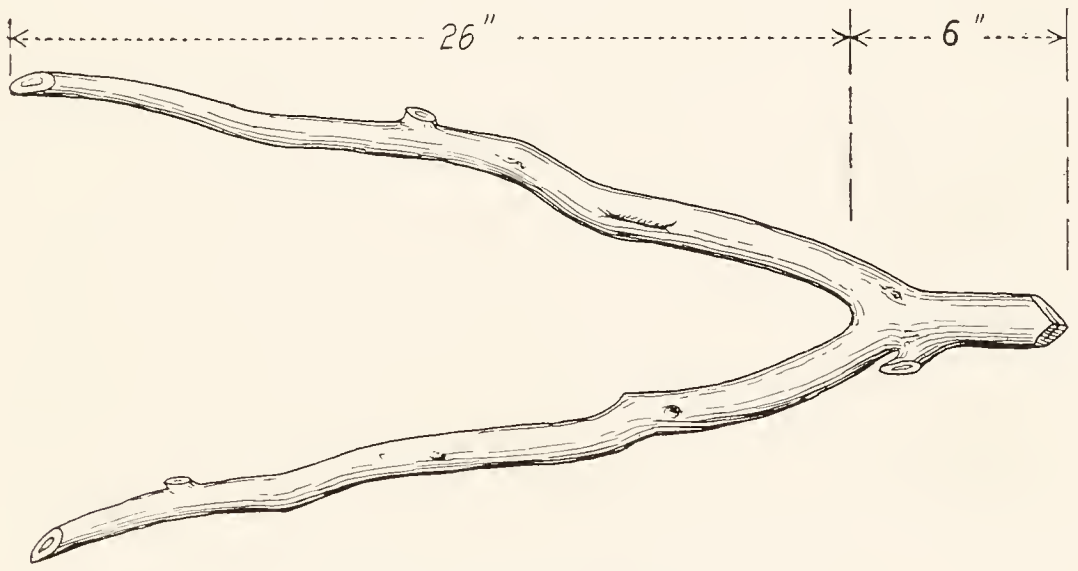
Other than such forecasting, the multifarious modes of divining rest usually upon some subjective quality of the prophet, even though he claims to be only the "medium" through which a superior power is speaking. It is this psychic class of phenomena that, for the last century, has got enough hold upon scientific philosophers to lead them into spiritualism. Unquestionably this is the broadest of all fields for fraud and superstition, and in the nineteenth century the world saw an amazing display of both, in the forms of catalepsy or trance, hypnotism, mesmerism, clairvoyance, spiritualism, end-of-the-world prophecies, and utopian schemes of society.

One of the most remarkable things about the practice of divination is the belief which the prophets themselves have in their systems of divining, or which they acquire if they are half skeptical in the beginning. An occasional lucky hit startles them into believing in their own practice because they cannot explain their success. That many of them are sincere is beyond question though there is no doubt that many have been fully conscious of their hypocrisy;—and as the source of their uncanny powers there is always the Devil as a *dernier ressort*.

The Divining Rod

When a farmer wants to sink a well, he usually casts about for a professional to tell him where to dig that he may be certain of striking a vein of water at a moderate

depth. Everybody, at least in rural communities, has heard of the practice of locating underground streams of water by means of a forked twig which, in the hands of a gifted carrier, points to such streams with unerring accuracy, and there are few communities that do not boast of at least one such practitioner. It is not so commonly known, however, that in earlier times the same means was employed to locate subterranean minerals and to find lost or hidden articles, and even to discover and detect criminals. The twig is known in English as a "divining rod" (Lat. Virgula divina; Ger. Wünschelruthe, Schlagrut; Fr. la baguette divinatoire; Eng. divining rod, dowsing rod). The person using it is often called a "dowser"; sometimes the terms water-witch and water-witching are used. In its most common form the divining rod is a forked twig or branch of apple or willow or hazel—presumably *witchhazel* would be most appropriate.



Willow Divining Rod.

With the rod in position, the dowser walks around over the land in which he is endeavoring to locate, say, a subterranean vein of water, and when he passes over such a vein the rod indicates the fact by turning in his hands and pointing downwards. Let the operator restore it to its upright position and again and again it will persist in turning and

pointing downwards. If he moves away and the rod is temporarily quiescent, it again becomes agitated and turns down whenever he crosses the vein of water. The twig may be carried pointing out horizontally or at an angle if only the proper relative position of the hands and branches is maintained. In fact it is commonly held in an inclined position between the horizontal and the vertical, as in the photograph. The disbeliever is inclined to ridicule the per-

Sylvanus J. Busby locating underground water at Whitingham.

formance, but as a method of divining it is a real cult, and to its disciples it is no joke. In awe-inspiring language, a German writer describes the performance of the dowser, and the tense moment of revelation thus:

Cautiously feeling his way he walks up and down the terrain to be explored. His elbows are pressed firmly against his body, the fore

arm thrust straight out in front of him, the hands, palm upward, clenched tightly around the forked twig which, in an inclined position, points forward. As if possessed of feeling it seems to stride on in front of the man.

Then suddenly the fork sinks. All efforts of the bearer to hold it fast are in vain, and from the lips of our seeker fall laconically the words "There is water." *

There is nothing dubious or hesitating in the movement of the twig; when it turns it turns suddenly and vigorously and the stiffer the twig the more vigorous its action. The skeptical do not consider this action mysterious although they do not usually wish to accuse the demonstrators of conscious fraud. As we shall see later, the mystery, which has been a cloud to the doubters and a halo to the believers, is itself mythical.

Professor Barrett ascribes the term "dowse," and from that "dowser" and "dowsing," to Cornish coal miners on their return from working in mines in Saxony. In that country the forked twig was used to locate coal deposits, and was called a "Schlagruth" (Eng. a striking-rod). The dialectic Cornish term for strike or hit was "dowse," which still survives among their sailors who "dowse the sail," and in America sailors sometimes say "dowse the glim" for put out the light.

Andrew Lang sees an outcropping of the popular acquaintance with the use of the twig in the English colloquialism "I twig your meaning."

The possibilities of the performance as a fun-maker were not lost upon Sir Walter Scott. In "The Antiquary" he makes game of the Westphalian parasite Dousterswivel (not to say Dowserdrivel), who finds water for a band of picnickers by means of the divining rod, amid ironical comments and satirical approbation of the rest of the company.

* From the Introduction to von Klinckowstroem's *Bibliographie der Wünschelrute,* by Dr. Edward Aigner.

The practice is very old and uncertain of origin. The earliest recorded use of a wand in discovering subterranean or concealed articles is ascribed to Abaris. He was one of those mythical characters that are only seen through clouds of doubt and uncertainty, and around whose names cluster fables and legends with an occasional scrap of what appears to be genuine history, that are often interesting and sometimes remarkable. He was reputed to be a Scythian living about 500 B. C. He traveled extensively, carrying or carried by an arrow, and performed wonderful acts of divining by its use, so that he was styled "a walking oracle." His arrow has been likened to the traditional broomstick whereon witches rode to their nocturnal meetings. An elaborate account of Abaris and his doings, including a comparison of his arrow with the later divining rod, is given in Bayle's Dictionary.

In recent times investigation of this subject has been taken over by psychic societies, as that seems to be the only road to an explanation of the mysterious behavior of the divining rod, supposing it needs an explanation. The literature of the subject is voluminous. There are traditions that go back many centuries, and passages in literature indicating that divining by means of sticks was known to the Romans before the Christian era began, and to the Etruscans before the Romans. There are indications of the practice among oriental nations before it was known in Europe. A bibliography by Count Karl von Klinckowstroem gives a list of 475 titles of publications from 1532 to 1911. They are in Latin, English, French, German and Dutch, and many of them are from the pens of able scholars. The writers are divided in their opinions, some staunchly advocating the genuineness of the performances and demanding a search for the cause, while others discredit the statements and jeer at their supporters. Two difficulties have to be met. In the first place there is no sufficient proof that the actions

of the divining rod result from an influence exerted by subterranean substances; and in the second place, if such influence were granted as a fact, efforts to explain it are as likely as not to be misdirected so long as it is not determined whether the influence is exerted directly upon the rod, or upon the person who is carrying it. If the former, the action is physical and needs an explanation that is independent of the operator, and then the rod should act equally well with all persons; if the latter, the explanation may be either physical or physiological.

Among English investigators, one who has given much attention to the subject and is certainly one most competent to speak with authority is Sir William Fletcher Barrett, F. R. S. E., M. R. I. A., professor of experimental physics in the Royal College of Science for Ireland, and ex-president of The Society for Psychical Research, of which he was one of the founders. On behalf of this society he made an exhaustive study of this subject and has published much about it in the *Journal* of the society. He rejects the idea of any action upon the stick, but is inclined to think that the successful dowser has some power akin to that of the clairvoyant.

One of the most important early works on the subject is by the Abbé Vallemont.* This treatise shows the efficacy of the divining rod in locating minerals of various kinds as well as water (no mention of oil), and also goes largely into its use in tracing, discovering, and detecting fugitive criminals, especially thieves and murderers. It gives a very circumstantial account of the celebrated case of the so-called "Lyons murderers." This story has often been told, but it figures so largely in connection with this subject that it may be briefly repeated here:

On the evening of July 5, 1692, a vintner and his wife, of

* *La Physique Occulte, ou Traité de la baguette divinatoire,* Par Pierre di Le Lorrain de Vallemont, A Amsterdam, 1696.

Lyons, were murdered in their wine cellar, and robbed, and the murderers escaped without leaving any clue to their identity. An acquaintance of the merchant recollected that a rich peasant of Dauphiné, Jacques Aymar, professed to be able to follow the trail of thieves and murderers by means of the divining rod. On the invitation of the *Procureur du Roi* Aymar appeared before him and assured him that if the officers would take him (Aymar) to the place where the crime was committed that he might there get the trail (*prendre son impression*), he would undertake to come upon the track of the criminals, follow them, and pick them out, in whatever place they might be.

They led him to the cellar where the murder was done. There he became much agitated, his pulse rose as if he were in a violent fever, and the fork which he held between his hands turned down rapidly over the two spots where the dead bodies of the vintner and his wife had been found. Guided by his divining rod, he passed along various streets, coming finally to the Rhone gate, but this was closed against him as it was night. The next morning he resumed his way, accompained by three witnesses, and after several curious indications he found that the criminals had taken to the river. He followed them down the Rhone more than thirty miles as confidently by water as by land, until he came to the military camp of Sablon, where he felt himself still more wrought up; he expected to find and detect the murderer in this crowd of soldiers; he was sure he was there, but he did not dare to test the soldiers with the wand for fear that they would maltreat him; so he returned to Lyons and was again sent from that place to the camp of Sablon with letters of recommendation; but he did not find the criminals there. He again set himself upon their track and followed them to Beaucaire, in Languedoc, where the famous fair was in progress, marking everywhere along the route the beds, the tables and the seats where they had rested. Search-

ing through the streets of Beaucaire his wand led him to the gate of a prison where, he declared positively, was one of the villains. They opened the gate to him and led him to a gathering of fourteen or fifteen prisoners. To them all he applied his rod, but this gave no indication upon any of them except a hunchback who had been brought in only an hour before for a petty theft. The peasant declared that the hunchback was one of the murderers; the latter denied it—swore he had no knowledge of the murder—had never been at Lyons. He was taken back over the same route, was identified at the various places where he had lodged, and under considerable pressure at Lyons he finally confessed that he had stood guard at the door while two others had actually done the murder, and put the best face on it that he could. He was eventually convicted and executed. Aymar resumed the chase, following the other criminals to Toulouse and finally to the frontier, where he abandoned it.

After this exploit the fame of Jacques Aymar spread like wildfire. Marvelous performances were accredited to him, in which he had no part at all. Soon after the Lyons affair, however, he performed an extraordinary piece of divination with his rod in tracing out and discovering the parents of a foundling child that had been left at the door of an asylum in Avignon. In the case of the murderers the pursuit lasted several weeks and had followed about a hundred and fifty miles of river and road before reaching the hunchback, and a still greater distance after that.

But there were skeptics.

The peasant accepted the invitation of the Prince of Condé to demonstrate his powers at the palace of the Prince in Paris. Here he failed egregiously in practically every attempt that he made, and gave such bungling excuses for his failure that at last he broke down altogether, admitted that he had no such knowledge or ability as he had professed, that his

pretended divinations with the rod were frauds, that he only practiced them for profit, and finally and especially that his deceptions were not so much due to impudence as to the manifest willingness of others to be thus deceived. It was as true then as now that "opportunities make rogues." He did not tell, however, how he accomplished his success when he did succeed, nor had his exposure much effect upon the public belief in the divining rod.

Vallemont's treatise was first printed about 1694, before Aymar's confession was made public.

Vallemont attempted to explain and account for the incidents which he narrated by a "system" which should suffice for all the phenomena, whether relating to minerals, fluids, vegetables, or animals. He evolved a theory that was analogous to the theory of magnetism that was accepted at that time.

It was purely speculative and has long ago been exploded, as the very assumptions upon which it proceeded are erroneous, but so closely does it resemble the present-day conception of fields of force and the Faraday conception of lines of force, that have been valuable in visualizing and helpful in studying magnetic and electric induction, that one might almost believe that Faraday had drawn his inspiration from this source.

Agricola, in his great work *De Re Metallica,* describes the use of the divining rod in connection with mining, more than three hundred and fifty years ago.

A letter to Professor Barrett, published in the Journal of the Society for Psychical Research, Mar. 1909, lays stress on the fact that a twig held so as to point horizontally outward, in the hands of a Mr. Jervois turned violently *upward* and hit him in the chest always in crossing a certain spot. When his companion, Mr. Charles D. Ovenden, Dean of Cloghen (writer of the letter), tried it, to his amazement the twig was bent *downwards* in spite of his holding it

tightly. Mr. Jervois then informed the Dean that with most dowsers the rod does point downwards. It acted for the Dean vigorously and unmistakably over subterranean water but was quiet above a water barrel and an open pond. He naively adds "the snowberry twig is much more sensitive

Seeking for Coal and Ores with the Divining Rod in the 16th Century.
From Agricola's *De Re Metallica,* MDLVI.

than the hazel" but does not say how much more sensitive one snowberry twig is than another!

Societies have been organized in Germany for the express purpose of investigating the phenomena of the divining rod, and municipalities in different parts of Europe have resorted

to this means to find sources of water supply; in France a subcommittee of the commission of scientific studies in the bureau of waters and forests of the department of agriculture was appointed in 1910 to investigate the subject, and in 1914 was still investigating. Presumably the war stopped the investigation temporarily, but it will take something more than a war to eradicate an error as deep-rooted as this. A flood of light will not cure the blindness of "those who won't see." In fact, the French government has recently begun new measures to locate water sources by means of the divining rod in the hands of professional dowsers. A special committee is to apply the rod to the desert of Sahara in the hope of opening up new oases there. In 1913, on the occasion of the meeting of one of these societies in Halle, Germany, a special endeavor was made to arouse interest in the subject in America. In an interview with a reporter of a New York newspaper, the writer of this was indiscreet enough to characterize the subject by a slang term of derision, which the newspaper printed and others copied. The remark drew the fire of various guns distributed from Maine to California and some in Germany, with the inevitable allusion to the things not dreamed of in Horatio's philosophy. The comments served to show, however, that the superstition has a strong hold upon popular belief in this country. Of various letters to the author, a scorching one is given in Appendix IV as a sample of the qualifications and the mentality of many who give themselves up to the fascination of the mysterious in nature, and resent any reflections upon their credulity.

In exploring a section of territory, the dowser frequently passes over good spots, the twig remaining undisturbed. "Wait" says the rod to itself (or says the bearer to the rod) in passing such places; "Wait; there is water here, certainly, but we are coming to a stronger vein presently, and it will be better not to act until then." In a little

while the twig turns. On digging there water is found and the rod scores a success—but it failed before it succeeded. The dowser can only explain this discrepancy on the part of the rod by saying that where the rod does indicate, either the supply of water is more abundant or it is nearer the surface than elsewhere, but he does not account for his or the twig's foreknowledge of the fact. This introduces the dilemma that the twig will not act unless the underground supply amounts to a definite quantity, or is within some short distance of the surface. He is hardly willing to agree to this, though he does associate the vigor with which the rod turns down with either the nearness or the abundance of the water supply, energetic action meaning a good stream near the surface, and feeble action a stream that is weak or at a great depth. Sometimes he overreaches himself by the absurdity of his claims. He will stop where the rod turns down, and restoring it to its upright position he attempts to hold it so. In vain; it will turn down in spite of him; and will repeat its indications as many times as the number of feet the water is below the surface. After so many repetitions it will remain quietly upright in his hands! Just what it would do if measures in feet were outlawed and only metric measures of length were permissible, is not known.

In *La Nouvelle Revue* for 1913 G. Fabius de Champville writes enthusiastically of evidence presented at the last preceding "Congress of Experimental Psychology" (March, 1911), vindicating dowsers and establishing their claim to marvelous powers. The Congress had agreed upon several special tests for them, of which one was "To find and delimit a subterranean cavity, and determine its depth." *

* For a circumstantial account of these tests see "Wünschelruten-versuche im Auslande," by Graf Karl von Klinckowstroem in *Zeitschrift der Gas- und Wasserfachmänner in Oestreich-Ungarn*, 1913 (Wien).

Four diviners declared they could do it. They were conducted to the Bois de Vincennes in which such a cavity, an old disused quarry, was known to the authorities but not to the explorers. Each of the four, independently of the others, marked out the cavity accurately, and determined its depth to be 15 meters, 85 centimeters; the depth was actually 16 meters! The precision of the results was supposed to be impressive and probably was convincing to some, but figures so precise in connection with an object so irregular as an old stone quarry—well, such measurements are not usual on such occasions. One of the men even located the pillars in the cavity. Most extraordinary of all, they declared *there was no water there,* which also was a fact. They gave scarcely less remarkable demonstrations with metals.

Just as it is now shown that many old-fashioned weather signs rested on true scientific principles, societies for the study of the divining rod ought to be able to show, if there were a real scientific basis for this practice or belief, that the early practice was an expression of scientific principles before they were well understood. But the study of the divining rod has been more like an attempt to convert a popular superstition into a scientific scheme; in that respect resembling astrology.

That the indications of the divining rod have been frequently correct is beyond question; too frequently, in the opinion of Professor Barrett, and under conditions too rigorous to be regarded as coincidences. The failures are said to be infrequent, but it is no exaggeration to say that they outnumber the successes a hundred to one, for who can tell how many failures occur, how many veins are crossed without the manifestation of any disturbance by the rod? How, indeed, can it be shown that it has failed or where it has failed except by excavating the entire territory it has traversed? If we should regard as failures not only

those instances in which it gives a false indication, but those in which it ought to indicate and does not, we should probably find that although the successes are numerous the failures are numberless. It is certain to succeed often enough to give it plausibility, for not only where water is scarce is the water-witch resorted to, but also in well watered regions where it is rare to sink a well to a depth of thirty feet without encountering a vein of water.

Attempts to explain the action of the divining rod have attributed it to three agencies: the devil; direct action of the undiscovered material upon the stick or upon the bearer of it; and some nervous or physiological quality in that person. The theory of diablerie has of course disappeared although, in the light of modern discoveries, it looks as if the arch-demon had been a special foe instead of friend of this instrument. Could any Imp of the Perverse show more devilish malice than to keep the rod dormant while it was carried above oil deposits, and so head off the magnificent results that have come to those who "struck oil"? Only since oil wells have been found by other means have they been included in the repertoire of the divining rod. Hard luck for the earlier dowsers!

In regard to the other two causes these questions always arise: If the phenomenon is an action on the twig, physical, what need is there of a man to carry it? If it is physiological or psychological, why use a twig at all? There are not wanting instances of men who professed sensibility to underground water, *if flowing,* and to minerals. The author has been importuned to investigate scientifically the extraordinary experiences of such an individual. His case, as represented, was very peculiar. If it should prove upon his return from prospecting without any twig or rod or extraneous apparatus of any kind that he had crossed subterranean water, this person would be fatigued; if common or low grade ores, he would have slight nausea; if the veins or

lodes of metal were sulphuretted, the ensuing nausea would be extreme, his pupils were dilated, and he suffered severe pains in the eyes and head; these effects were heightened if he carried a freshly cut staff in his hand, or even a green leaf between his lips. When he is walking above these substances he experiences only a sensation of being drawn toward them or attracted—it was the *after effects* that he found so prostrating. Radioactive substances and an excited Crooke's tube disturbed him violently. He was aggrieved that physicists would not take him seriously, and indeed the impression is not unusual that science has so much to reveal that scientists ought not to object to chasing phantoms.

So far from the war interfering with water-witching, it sometimes stimulated it. In the progress of an army through arid regions every sort of measure would be employed to find water for the soldiers. A record by Lieut.-Col. H. Pirie Gordon of the remarkable march of General Allenby's forces through Palestine to the conquest of Jerusalem was published in the *Palestine News* for the Government Press and Survey, of Egypt (Cairo, 1919), and a review of this in the *Journal* of the Royal Geographical Society says:

> Wells were sunk where water had never been known to exist. At Abu Ghalyan, after two failures, the services of a "water diviner," an Australian engineer, were engaged. Two wells, sunk at places indicated by him, reached an abundant supply of water at thirteen feet depth.*

This Australian engineer, Stephen Kelly, is mentioned in dispatches from London as recently as Jan. 7, 1920, as claiming to be "the only man in the world who is known to be able to locate water *without the use of a divining rod.*" Alas, poor old rod! Having served its day it is now to be shelved as no longer needed, like many another creature that has outlived its usefulness. Mr. Kelly says "When I pass over ground beneath which there is water, my thumbs crossed

* *The Geographical Journal,* for November, 1919.

over copper" (mark that detail), "I receive immediately a series of shocks like electric currents, which pass up my arms and seem to finish in my chest." He can tell with great accuracy the depth and quantity of water present, but extravagant as his claims are, he might claim much more and still fall short of some of his predecessors. "The only man in the world that can do it" is likely, however, to keep on appearing and reappearing indefinitely. Whether the effect is produced directly upon the twig or the man, it has been ascribed vaguely to electricity as the only scapegoat that can carry such a load of eccentricities. Sometimes the dowser contents himself with saying "It is electricity" and lets it go at that. To anyone who is satisfied with an explanation like that, an explanation like that is satisfactory.

How and Why the Rod Turns in the Hands of the Diviner

It is a maxim of science not to have recourse to an obscure or complicated explanation if a plain and simple one is at hand. Probably psychology has little to do with the action of the divining rod, the underground substances still less, and electricity nothing at all. Investigators have been so insistent upon seeing the supernatural as to overlook the natural; so intent upon explaining the mysterious as to miss the obvious, and have wasted much effort and ingenuity in endeavoring to explain the mystery of a part of the conduct of the rod that is an inevitable consequence of simple mechanical conditions, that ought not to puzzle a physicist or an engineer who is acquainted with the mechanics of materials. The turning of the rod is not mysterious; why shouldn't it turn if it has a chance? Not only can "anybody" work it, he can hardly help doing it.

The mechanics of the turning is not hard to make plain, even with few technicalities. It is simply a case of what the physicist calls "unstable equilibrium." The action of the right hand in bending its own branch of the twig is to

make a thrust upon the head, pushing it toward the left, and that of the left hand thrusts towards the right, the line of thrust in each case passing through the axis line of the head, provided the lines of the twig are in the same plane as that in which the hands are acting. If, from any cause, the head moves out of this line of action, and the hands continue their effort in the same direction as before, then the force from the hand will no longer pass through the head of the stick, but will pass behind it if the head has moved forward, i.e., from the operator, or in front of it if the head has turned toward the operator. In either case the rod has lost its position of equilibrium, and the force from the hands has introduced a twisting or turning effort upon the rod which becomes greater the further it departs from this position. Thus the rod might as readily fly upward as downward from a horizontal position if not in some measure influenced or controlled by the bearer. A tendency on his part to turn the thumbs toward each other (the easiest way) would direct the movement of the rod downward. *It is only when the bending force that is exerted by the hands is in the same plane with the branches and the stem that the twig can retain its position and remain quiet with its branches bent in a strain,* and although this adjustment is apparently casual and crude it is really delicate, while being at the same time *unstable.* An unperceived tremor may start the avalanche, an unpremeditated twitch of the hand or a misstep in walking, any diversion or distraction of the person holding the twig, is enough to disturb the adjustment between the action of the hands and the reaction of the stick, and upon the slightest departure of the latter from the position of equilibrium, if the hands do not follow it and *change so as to keep their bending effort in the same plane with the twig,* the effect is to *force it further out of that plane.* "Follow" that change of position is precisely what the operator does not do. Seeing or feeling the in-

cipient movement of the stick, he involuntarily clutches the branches more tightly or grips them more strongly, to hold it back, especially if he is a novice, and in so doing merely intensifies the turning effort of the rod so that, by the time the rod has reached a horizontal position, his hands may twist off the bark or split the wood. That is its most fetching performance and when this occurs the onlooker doubts no longer. There is no need to explain this movement of the twig, which occurs without conscious effort on the part of the operator to make it move; *it would be more remarkable if it did not turn, and there would be more need of an explanation of its failure to do so.* More than this: if the twig were mounted mechanically, strained in the same way but with the same opportunity to turn as when held in the hands, and the machine in which it is mounted were trundled over uneven ground there is no doubt that the twig would presently lose its equilibrium and would turn upwards or downwards, with no human intervention whatever. It is strange that this mechanical action has not been pointed out before. In the great bulk of literature on the subject that has come under the notice of the author, in only two places has this feature been considered, and there scarcely more than hinted at. One of these is in Agricola's *De Re Metallica,* 1556, already cited, and the other in an article in the *American Journal of Science* in 1826, nearly a century ago. This paper, unsigned, but apparently by the editor, the elder Professor Silliman of Yale College, recounts many absurdities in the use of the divining rod and concludes: "The supposed laws of the divining rod are absurd. It goes blindfold when the diviner is blindfolded; and the cherry, the peach, and the hazel itself are excelled in the subtility of their divining motions by dry and nervous whalebone." This reference to the "subtility of dry and nervous whalebone" fits in with what we have just been saying, for the stiffer the twig the more vigorously it acts, and the more springy it is the more

ready it is to act. This also explains the difference in the sensitiveness of various kinds of twigs.

The other point of common remark, calling for explanation, is the repeated indication by the rod when passing over the same place. This is doubtless exaggerated. It does not occur nearly so frequently nor so exactly as is commonly supposed, and is by no means to be depended upon if the operator is blindfolded.

One of the latest official documents on the subject is a historical account with a bibliography, by Arthur J. Ellis.* This book of some sixty pages presents the various phases under which this method of divining has appeared, with the extravagant claims that are made for it, and also comments on mechanical devices that have been invented to serve without regard to the individuality of the dowser. The bibliography is especially valuable, comprising 572 titles brought up to date (1917), thus greatly extending that of Klinckowstroem. In an introduction to the work, O. E. Meinzer of the U. S. Geological Survey says:

"It is doubtful whether so much investigation and discussion have been bestowed on any other subject with such absolute lack of positive results. It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited. . . . To all inquirers the United States Geological Survey therefore gives the advice not to expend any money for the services of any 'water-witch or for the use or purchase of any machine or instrument devised for locating underground water or minerals.'"

The lengths to which this superstition has been carried by intelligent people are beyond belief. Every age prides itself upon its intellectual advancement, and boasts of its superiority over powers of darkness that would blind its vision or impede its progress. When witchcraft and magic were accepted as genuine exhibitions of real though myste-

* *The Divining Rod. A History of Water-Witching, with a Bibliography,* by Arthur J. Ellis, Water Supply Paper 416, of the United States Geological Survey, 1917.

rious power, the divining rod might have been thought not impossible; but even now, in this latest period of enlightenment, we can only re-echo the words of a writer concerning the mental attitude of cultivated people in France two centuries ago: "Our age," says he, "is as easy to be imposed on as any whatsoever. . . . We have no reason to say the World is grown wiser nowadays. It is the Same it ever was; every Delusion which flatters its passions, is pleasing; it is not ashamed of being convinced it was imposed upon; nor has it upon that Account, the less Respect for the Imposter; and cries out as much as ever, against the Incredulity of those who will not suffer themselves to be deceived." (Bayle's Dictionary, Article "Abaris.")

Palmistry

If astrology stands first in scientific divination, palmistry is a good second, though the latter is of necessity confined to the individual. It has nothing to do with historical, economical, or national affairs, except in so far as the special individual is concerned in such things.

Says a recent author: "Never was there a hand that did not exactly reflect the brain that directs it, and this is the basis from which a scientific study of the hand must begin."* A complete system of chiromancy or palmistry takes account of all the markings or formations of the hand, and their relative values, but there are two that are more important than the others, namely, the lines and the mounts. The earlier palmists laid more stress upon the lines, while with the moderns the mounts receive more attention. In one other matter, also, modern practitioners are at variance with earlier ones and to some extent with one another: the earliest treatises rested the subject wholly upon astrology; not only the characteristics of the individ-

* *The Laws of Scientific Hand Reading. A Practical Treatise on the Art Commonly Called Palmistry,* by William G. Benham.

ual, but the markings of the hand by which his character is revealed; and some still adhere to that view, but others now disclaim any astrological or planetary influence in fixing the markings of the hand. Speaking of the mounts Mr. Benham says

"The names which appear on the Mounts are not used in any astrological sense, but because they have been so long in use that the mention of each name instinctively brings to mind certain attributes. . . . They are not used because it is considered that planetary influences are necessary, or play any part in our science." *

An English writer says "Chiromancy is nearly as ancient as astrology, with which it is *indissolubly connected,*" and takes sharp exception to a statement by a "well known writer" who disavows astrology in a sentence very like that just quoted from Mr. Benham.†

It is a peculiar satisfaction to writers on chiromancy to be able to back their statements with the authority of Aristotle who wrote extensively on this subject. Says one of the best French authorities,

"Aristotle declares (*De coelo et mundi causa*) that not without reason are the lines graven in the hand of man, and that they are due, above all, to the influence of the heavens and of a distinct human individuality." ‡

We need not go into any extended exposition of palmistry. Its remarkable possibilities may be seen from a consideration of only one of the sets of things in the hand, upon which character reading is based; that is, the Mounts. These are prominences surrounding the central part of the palm, below the creases that are at the base of the thumb and fingers. If we divide the thick part of the hand at the edge opposite the base of the thumb into two, there are

* Ibid.

† *The Influence of the Stars. I, Astrology; II, Chiromancy; III, Physiognomy,* by Rosa Baughan, London, 1889.

‡ *Chiromancie nouvelle. Les mystères de la main.* Adolphe Desbarolles, Paris, 1859.

seven mounts in all, which, beginning at the base of the thumb, and following the fingers, are successively the mounts of Venus, Jupiter, Saturn, The Sun, Mercury, Mars, and The Moon. In earlier practice these names signified the heavenly bodies which control human destinies, and the effect of which is directly manifest in the peculiarities of the mounts themselves; in some of the later practice they are simply the names of the deities by which the mounts are known.

Both ideas are shown in this scheme:

Luminary	Position of Mount	Deity
Jupiter, ♃	At base of fore-finger	Jove or Jupiter
Saturn, ♄	At base of second finger	Saturn
Sun or Sol, ☉	At base of ring finger	Apollo or Sun
Mercury, ☿	At base of little or ear finger	Mercury
Mars, ♂	At middle of outer edge of palm	Mars
Moon, ☽	Outer edge of palm near wrist	Luna or Moon (Cynthia)
Venus, ♀	Base of thumb	Venus

There has been more uncertainty about placing Mars than any of the other bodies, but the modern arrangement places an "Upper Mars" between Mercury and the Moon, and a "Lower Mars" between Jupiter and the lower joint of the thumb. The depressed central part of the palm has always been known as the "Plain of Mars."

If any one of the seven mounts is of marked prominence, it puts its possessor into one of seven classes or types into which the entire human race is divided; he may be a Jupiterian, or Apollonian, or Martian, the superiority of any mount signifying well-defined traits of character, fitness for particular lines of work, and congeniality with other people whose hands show a like temperament, while a de-

pression or an inferiority of a mount has a contrary interpretation. These seven mounts in palmistry serve the same purpose in classifying human beings as is served in astrology by the twelve houses of heaven, dominated by the twelve constellations of the zodiac, except that these latter concern every sort of mundane creatures and affairs. The general

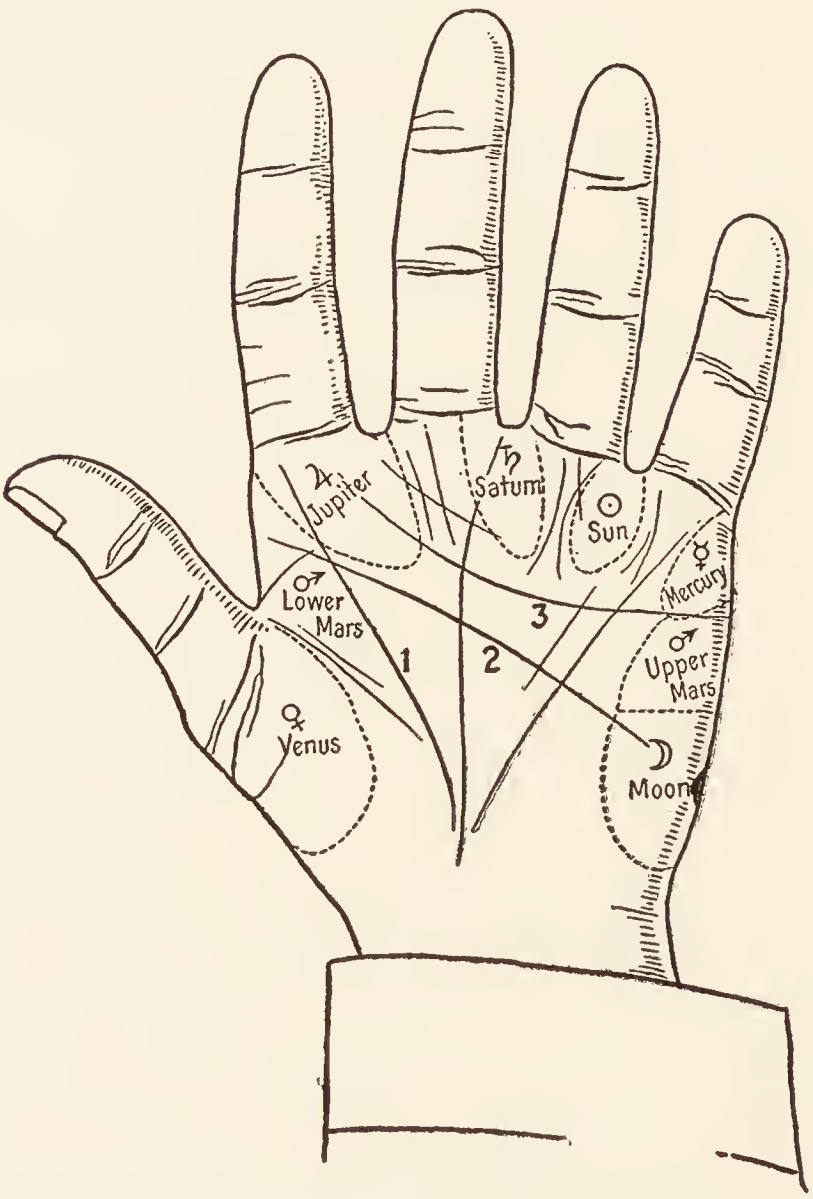


Diagram Showing Mounts and Principal Lines of the Hand.

types of character thus symbolized by prominence of the mounts are

The Jupiterian; marked by ambition, leadership, religion, honor, love of nature.

The Saturnian; soberness, wisdom, sadness, superstition, gloom.

The Apollonian; brilliancy, success, and an artistic, dashing, happy temperament.

The Mercurian; shrewdness, industry, scientific mind, business quickness.

The Martian; resistance, courage, coolness, calmness, aggression, qualities of the warrior.

The Lunarian; imagination, fancy, mysticism, coldness, selfishness.

The Venusian; love, sympathy, music, grace, passion.

Of course these general traits are modified by a thousand other considerations drawn from the lines, and the shape and marking of the fingers, as well as the general form and condition of the hand. It is interesting to compare this classification, however, with the significance of the sun and planets, on page 36.

If a mount is shifted from its normal position, the qualities associated with it are modified by those of the neighboring mount toward which it is displaced. In the diagram, each one of the mounts at the base of the four fingers is shoved over to the right.

Among the lines of the hand the three principal ones are the Life Line, the Head Line, and the Heart Line, numbered respectively 1, 2, and 3, in the above figure.

How the Hand Affords an Infinite Variety of Interpretations

The schoolboy studying algebra is always glad to get away from "Permutations and Combinations," but they demonstrate the multitude of possibilities in interpreting by palmistry and show its adaptability to the widest diversity of character, for this adaptability arises from the combinations of the markings that are possible. Neglect, for the present, everything connected with the shape of the hand and fingers, and the complex set of lines in the palm; the variety in the nails, etc.; and consider only the mounts. If all are normally developed the subject is probably well

balanced but (*a*) if any one mount is especially prominent that fact at once opens up one order of characterization, and as it might be any one of the seven, here are at once seven possibilities of interpretation open to the palmist; that is, we must have as many combinations as are possible of six out of seven things, combined with the other one. This number is seven.

(*a'*) The same would apply if any one mount is especially small or undeveloped; this affords the opportunity for a negative interpretation, for now the subject is deficient in the qualities indicated by the prominence of that mount, and there are seven such possibilities.

(*b*) Suppose two are prominent, no matter which two; there are now possible all combinations of seven things taken five at a time, that is, twenty-one, but (*b'*) there might be two at a time depressed instead of elevated, and this would give twenty-one possibilities.

(*b''*) Instead of both being extra high or low, *either one* might be high and the other low, and so we have forty-two more possibilities, or eighty-four because of a departure from the normal of only two out of the seven mounts.

(*c*) If three are unduly large, the combinations of seven things taken four at a time are thirty-five in number, and if they are unduly small, again there are thirty-five cases to interpret; thus the three may constitute an irregularity by all three being large, or any two of the three large and the remaining one small, or one large and two small, or all three small; and the possible abnormality of three mounts opens up eight times thirty-five, or two hundred and eighty possible varieties of character.

This kind of calculation is exasperating and we need not carry it further, but it demonstrates that discrepancies in the seven mounts as to their size alone will produce about a thousand modifications of character. Now when it is remembered that the general conformation of the hand

the peculiarities of the joints and the various lines in the palm may all be interpreted separately or in conjunction with the mounts, and that the five fingers considered as to excess or defect in length separately or in combination just as the mounts were considered will afford a large number of interpretations, it is easily seen that the palmist need be under no apprehension of repeating himself in reading the character of many individuals in close succession.

Of course this wide variety is not due to palmistry *per se,* but to the fact that there are seven mounts entering into combination; precisely the same would apply to interpreting physiognomy if it were based upon combinations of seven features, as the eyes, ears, mouth, nose, and chin. The idea that an individual from his birth is of a distinct type (one of seven recognizable types) and that his hand will infallibily take on such a form and such markings as go with all the people of that type is one toward which palmists today seem to be inclining more and more, but it has the danger of inverting the relation of the man to his environment. Hands of different persons do differ naturally, as indisputably as do the persons, but not enough account seems to be taken of the kind of work they have had to do, whether they were especially fitted for it or not. Instead of the hand presaging the kind of handicraft for which its possessor is temperamentally fitted, its form is largely due to the work to which it has been applied. If a blacksmith has large, strong hands, and a pianist has long, flexible fingers, these are slight facts upon which to predict that a possessor of large strong hands would make a good blacksmith, or that one whose fingers were long, slender and supple might not be hopelessly unfit to become a pianist. The man is not a blacksmith because his hand is suitable for such work, more probably his hand is what it is because he is a blacksmith. The "son of toil" is bound to be "horny handed," but as often as not he is in

a state of revolt against his necessity to toil, and makes a poor showing in it.

In either the astrological view or its alternative, the reading rests upon assumptions that have not been proved to be true, and until they are so proved this scheme of divination is no better than any one that is pure invention. It is certain to give correct indications sometimes, and yet it has unlimited possibilities of mistakes and absurdities. Its advocates insist that the intimate association of the mounts with a distinct type of character, of the lines with special mental and moral traits, etc., has been so often and so exactly verified as to put the matter beyond question and to warrant them in regarding the assumptions proven. The skeptics, on the other hand, think that all this corresponds to the fallacy that distinguishes prophecies in general, namely, *coincidence* combined with the fact that one success outweighs many failures. The more varied and detailed the interpretations the greater the likelihood that some will be correct.

The following example of medieval extravagance, and the conservatism which it produced in a hand reader of that time, is not more superstitious for its day than are the modern attempts to connect the numerous and varied lines and markings of the hand with attributes of human character in the greatest minutiae of detail:

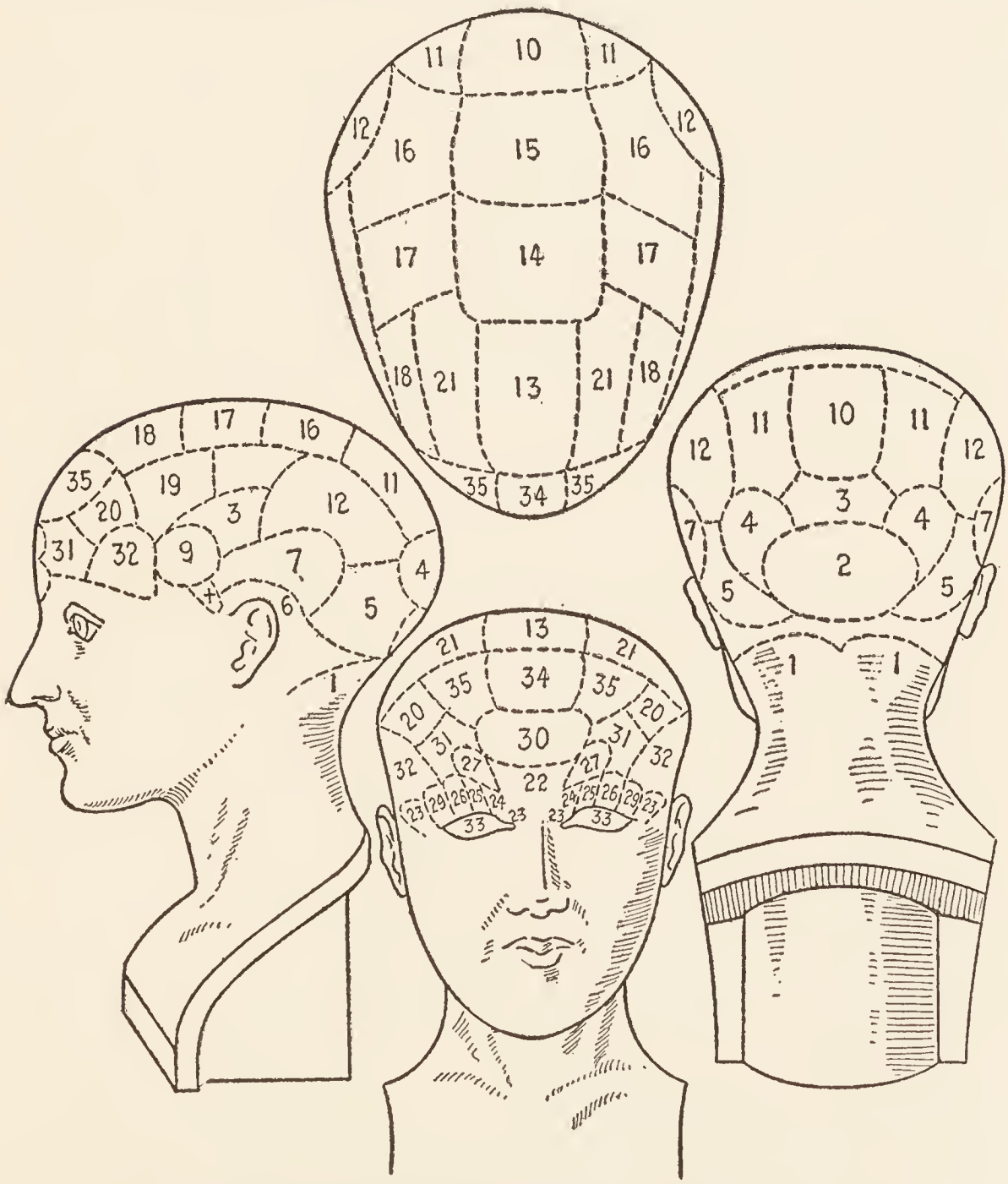
"If there be about the first joynt of the thumb, a crest like a ring going round about, and dividing the thumb, many do stifly judge and say, that that man shall be hanged. The which thing I have proved true in one man, but because I have seen many hanged which have lacked that mark, I leave it as uncertain." *

Phrenology

Whereas Aristotle and the earlier philosophers regarded the feelings and emotions as proceeding from the heart, later physiologists decided that the brain is the organ controlling these attributes, and that the display of any one is

* Indagine, *Palmestry and Physiognomy, etc.*, London, 165—?

dependent upon the functioning of a particular part of the brain. When it became known that injury to certain parts of the brain invariably resulted in the impairment of equally certain faculties, it was an easy inference that if any special traits of character were largely developed the corresponding portion of the brain would have grown vigorously, and would be prominent among the other parts of the brain. Then the way was open for a beautiful piece of theorizing. No matter under what auspices one was born, as he developed, his brain would shape itself to accord with



Map of Character outlined upon the Human Skull according to Phrenology.

his temperament, and by an examination of the former the latter could be determined. But character is formed in the early years of life, and in those years the skull is yielding and formative, and the brain will not only take its appropriate form but will give to the skull a shape such that its unevenness will reveal the characteristics of the brain, and enable the practitioner to read the character of its owner.

A systematic apportionment of traits of character to different parts of the brain, together with the corresponding evidence of specific brain development and brain functioning in corresponding prominences of the skull, practically began with Dr. F. J. Gall, of Vienna and Paris, about the beginning of the nineteenth century. His system was quickly taken up and pushed by John Gaspar Spurzheim of Germany, George Combe of Edinburgh, O. S. Fowler and others in America. The figure shows the arrangement of "bumps" and the traits of character they indicate, as they were accepted by the early phrenologists and have been continued with little modification ever since.

The following classification is the key to the diagram:*

Affective		Intellectual	
I, Propensities	II, Sentiments	I, Perceptive	II, Reflective
1, Amativeness	10, Self esteem	22, Individuality	34, Comparison
2, Philoprogenitiveness	11, Love of approbation	23, Form	35, Causality
3, Concentrativeness	12, Cautiousness	24, Size	
4, Adhesiveness	13, Benevolence	25, Weight	
5, Combativeness	14, Veneration	26, Coloring	
6, Destructiveness	15, Firmness	27, Locality	
Alimentiveness	16, Conscientiousness	28, Number	
7, Secretiveness	17, Hope	29, Order	
8, Acquisitiveness	18, Wonder	30, Eventuality	
9, Constructiveness	19, Ideality	31, Time	
	Unascertained	32, Time	
	20, Wit or mirthfulness	33, Language	
	21, Imitation		

* *System of Phrenology,* George Combe, Edinborough, 1834.

All this greatly stimulated physicians and physiologists in efforts to locate the traits of character in the brain, and rapidly opened the way for extremists and quacks. No matter how profound the depths that are explored, or how startling the scientific discovery that results, the discoverer is promptly called upon to prove its "utility." The real student and scholar is always met by the philistine with the question "Of what real use is your theory or your knowledge?" and the question is likely to carry with it a sneer that is only half concealed. While a science is growing, its application is pushed in practice, and this, in turn, stimulates its growth; there could be no reasonable objection to this, but oftentimes a limited view or a narrowly restricted portion of the science, is taken and elaborated in great detail and made to cover a large range of human life and experience. Here is where the pretender and the quack find their opportunity. Dr. Gall himself had distinctly declared that he did not teach that a strongly developed propensity would always be attended by an enlarged portion of brain, or a corresponding bump of the skull, but that the character must be deduced from a complete consociation of all the brain formation, yet, notwithstanding this declaration, long before the genuineness and the correctness of the above-described chart could be established, peripatetic would-be phrenologists were traversing the land, examining heads, making out charts of character, and reading out the aptitudes or inaptitudes of the wondering auditors. This resulted in large preversion of small scientific knowledge.

An amusing instance of the misapplication of this doctrine occurred in the experience of the distinguished alienist the late Dr. Allan McLane Hamilton, which he relates as follows in "*Recollection of an Alienist*":

"In an Italian murder trial . . . much testimony had been given by an anthropologist and craniologist in regard to the peculiar

shortness of the head of the defendant. So improbable was his testimony that on my way down town the next morning I stopped at the shop of Dunlap, the hatter, and procured a number of *conformateur* tracings, which I gave to the District Attorney, whose first words to the witness who resumed his place on the stand were, 'Doctor, *extreme length* of the head is also a stigma of insanity, is it not?' To which the witness at once assented. 'Now, Doctor, I will show you some tracings and get you to give your opinion of their meaning.' The witness at once admitted that they looked as if they might have been made from the heads of insane people —'in fact he was quite sure that all these people were insane to some degree' or words to that effect. 'Well,' said his merciless cross-examiner, 'would it surprise you to know that the first series were taken from the heads of William H. Vanderbilt and his sons, and the *last is from the head of his Honor, the judge who presides in this case?*'"

The explosion that followed was allowed to pass without reprimand from the Court.

In America, at least, a good deal of the exploitation of phrenology was directed along the line of sexuality, animal qualities, indications that would determine happy or unhappy married relations, etc., involving much that faddists today like to present under the name of eugenics. This did not diminish popular interest in the subject—perhaps it augmented it, for no one could doubt the utility of such knowledge as phrenology offered. It opened clear avenues to the attainment of happiness and wealth; it guided the passions without danger of making mistakes; it straightened and leveled the road, and diminished the labor that led to success; schools were established and courses of instruction given in phrenology, and soon the new and vitally important science was being disseminated by a horde of semi-professionals, whose principal qualifications for their undertaking were brass and nerve. It was not rare to come upon such a "Professor" in an obscure district school house lighted by a few candles stuck in ink bottles, lecturing sagely to a coterie of men, women and children, who were

as much awed by the easy familiarity with which the speaker tossed a human skull in the air or from one hand to the other, as by his analysis of character and his skill in reading it.

The public, however, was ripe for the movement and responded, so long, at least, as the novelty lasted. The wave of interest seemed to be at its highest in the years 1840 to 1850, after which it subsided. It was another example of mass-psychology, in the dominating effect of one novel idea, persistently pushed.

Its propaganda was met by pen, by pencil, and from the platform of the orator. George Cruikshank ridiculed it in a series of his witty drawings in 1826. Most of the efforts to confute it were like fuel to a flame, and when this stimulation subsided, the doctrine itself died of inanition. Scientific brain study today practically disowns the entire scheme of phrenology.

Physiognomy

In the face especially does the variety of features make an excellent basis for the reading of character, and the artist has to learn how to express varied emotions and feelings by his *delineation* (tracing the *lines*) of the features, so as to display any disposition, gay or somber, mercurial or saturnine; and to represent hope, fear, love, hate, the whole gamut of passions.

The form and markings of the hand, and face, and the skull constitute in each case a system of character-reading, but in divining from either of these separately the reader may encounter markings that are contradictory; the traits indicated by one mark may modify or annul those of another, and the reader has to take this into account in making up the character. While a skilful artist can safely count upon his ability to depict the features so as to show character, it is not so safe to infer character from the

features of an actual person; for in individuals who are distinguished for the same kind of talents, there are sometimes facial contrasts that appear to be contraditions. Palmists exhibit the hands and phrenologists the skulls of noted individuals, creditable and discreditable, whose characters were clearly indicated by their physical formation, but it would be illuminating if we could sometimes see

Ludwig van Beethoven, Sketched from Life by Johann Peter Lyser.

alongside of these the portraits of celebrities of like nature, whose form and features were strikingly different from those chosen for demonstration. We need not seek far for examples: Whatever it may be especially that constitutes a

musician or the musical temperament, it would scarcely be denied that both Beethoven and Mozart were musicians *par excellence,* and yet one could hardly conclude so from their faces; for if Beethoven's head and face are characteristically those of a musician, it is impossible to take those of Mozart or Wagner to be such. Beethoven's nose was short and stubby, that of Mozart was long and pointed—but perhaps the nose has nothing to do with music; Beethoven had a shock of curly and unmanageable hair, Mozart's hair was silky and obedient to the brush—but maybe the hair means nothing in regard to musical talent; Beethoven's cheeks were pudgy, Mozart's were thin; Beethoven's face was short and broad, Mozart's long and narrow; which face, then, indicates the musician? It is generally admitted that Lyser's drawing of Beethoven is very lifelike,* and this, with the bust that was made from actual plaster casts, enables us to make up his physiognomy pretty correctly. The portraits here shown are those most approved by critics, and show that there is not much encouragement for physiognomy in carrying the comparison further. If the hands are compared, again we find a sharp contradiction, for Mozart's were well adapted to playing the piano or for fingering any musical instrument, while Beethoven's fingers were flat at the ends and so short that he could not span an octave. The artists were alike in being both under size, neither exceeding five feet six in height, but Beethoven's figure was stocky, while that of Mozart was slender; which of the two, then, bore the marks of the musician? If Physiognomy acknowledged the one, would it deny the other? Apparently there remains little chance for it to detect their similarity in talent unless it should be

* Of Lyser's sketch says Von Frimmel (*Beethoven's äusserliche Erscheinung*), "Dr. Gerhard von Breuning who, as a boy, frequently saw the great virtuoso (Tonmeister), states in his book *Aus dem Schwarzspanier Hause* that the manner of Beethoven's carriage is well hit off in Lyser's drawing." The face, he thinks, is not so well done. The nose is here made too pointed.

by their phrenological bumps, and of those there is no record.

It is plain that although the artist knows that if he draws lines in certain shapes and positions he will depict certain emotions, it does not follow that an actual face that is marked by those lines has those emotions back of it.

And so we come to physiognomy in the large sense of the term. As such it comprises all that could belong to the interpretation of character from any and all portions of the body, and in this we reach a phase, the consideration of which places the subject upon a higher plane. There is no doubt that we all read character to some extent from physical appearance. We do it involuntarily long before we learn how to do it. Most of us never do learn how, but we never meet a stranger privately or see a man in a public character without sizing him up or forming some estimate of him from the cast of his features, and his carriage and movements; often we are predisposed thereby to likes and dislikes—and we are continually making mistakes. It is the boast of some that their first impressions are the truest, but the bulk of experience is the other way, and the reversals are often as decided as the confirmations. As to features in detail, their relations to character are too contradictory to justify the extent to which reading from the hand or the skull or the face has been elaborated. In *Character Reading through Analysis of the Features* (by Gerold Elton Fosbroke) definite characterization is made from each separate feature; and there is probably not one of those interpretations that cannot be confirmed in the experience of the reader—and not one that is not contradicted—but one confirmation outweighs many contradictions.

Aristotle's treatise on physiognomy took into consideration the proportions and development not only of the face, but also of the head, neck, limbs, and torso, and the significance

of any or all of these in respect to character and temperament.

In the latter part of the sixteenth century, a work of the same nature, "De Humana Physiognomia," was produced by

Wolfgang Amade Mozart, after the Medallion by Posch in the Mozarteum at Salzburg.

Bust of Beethoven by F. Klein.

an Italian savant, John Baptist Porta, and this and Aristotle's treatise were the principal standards of reference for artists as well as philosophers for many years.

In 1787 appeared the classic on this subject from the pen of the Swiss naturalist Lavater; a monumental work which has often been reprinted either abridged or in full, and with additions.* In thirteen *"etudes,"* it discusses the entire range of human characteristics as they are indicated by the body, and also shows comparisons of human beings with other animals. By physiognomy the author means all the external markings of the body that may indicate the man within, and they include pose, gesture, movements voluntary and involuntary, the body in action as well as at rest. As

* *L'Art de Connaitre les Hommes par la Physionomie,* par Jean Gaspard Lavater.

a broad-minded, philosophic discourse on the display of character by the human form and movements it is more than imposing, it is magnificent: and when its poise, its deliberateness, and its sagacity are appreciated, the pretensions of lesser lights to find in the trend of every line and in every involuntary movement an index to some specific trait of character are ludicrous.

The author does not fail to recognize the earlier treatises, but discusses them rationally. He has no patience, however, with those who would link physical signs with astrological; he scorns the plan of limiting the readings to a narrow scheme like that of the hand or the face, and shows that practitioners under such limitations contradict themselves as well as one another. It is true that of all the sources of expression he does attach much greater importance to the face than to any other one portion of the body, but here, too, he is critical of the work of his predecessors. Especially had it been, as it still is, the *sine qua non* of success in portraiture, whether in painting or sculpture, but particularly in painting, to know how to line and tint a face so as to give an unmistakable character to the subject, whether that character be true or false. Accordingly, many of Lavater's illustrations and comments are drawn from the work of great masters. Charles LeBrun, painter to King Louis XIV, had a system of his own for drawing character, and Albrecht Dürer employed a formal anthropometric method for the same purpose. Both of these are critically reviewed by Lavater. He makes liberal and especial use of the drawings of Hogarth and Holbein. The figure (p. 163) by the latter artist is an excellent example. We need not accept this as an authentic portrait of Judas Iscariot, nor are we certain that it closely resembles him, but it is doubtless a good picture of how the artist thought he ought to look to be *true to type*.

The work of Lavater rose so high above the level of

any others extant at that time that little was added to it for more than eighty years.

In 1867 the great naturalist Charles Darwin was studying the "Expression of the Emotions in Man and Animals," under which title he published the results of his investigations a few years later. His immediate purpose, however, was not to determine a key to character by physiognomy, but

Judas Iscariot, from Lavater; after painting by Holbein.

to see in how far any muscular or physiological action exhibited by the lower animals was also displayed by man in expressing an emotion or a feeling like that influencing the beast. He addressed a questionnaire of sixteen queries to competent observers in all parts of the world, living among savage as well as civilized people; and from their replies, as well as his own observations, he produced his celebrated treatise.

Darwin's work, published in 1872, is the most notable advance that has been made in this subject since Lavater, a position which it has held for half a century.

Within the last few years, Dr. Katherine M. Blackford

and A. Newcomb have published several works to show how to analyze character by physiognomy, and how the science may be applied to advantage in placing men and women in vocations to which they are suited. This is a repetition of what palmistry and phrenology assumed to do, without their extravagant and irrational pretensions, and with more regard for well-determined relations between character and its outward expression.

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The Cacique of Guatavita Surrounded by Indian Priests on a Raft, upon which he was conveyed to the Middle of the Lake on the Day of Oblation. This object, taken from the lake of Siecha some miles from Lake Guatavita, was of gold, nearly ten inches in diameter and weighed about nine ounces. By courtesy of Dr. H. J. Spinden of the Peabody Museum, Harvard University.

GEOGRAPHIC MANIA

El Dorado

Among the effects produced by Columbus' discovery of a new world and by the extraordinary tales which the discoverers told of the land—its animal, vegetable, and mineral wonders—was an insatiate greed for gold and precious stones to be taken from the savage inhabitants. The famous band of conquistadores that took reckless chances and gave to their expeditions an air of romance; explorers of high rank and noble family; were associated with ruffians and villains who would stop at no violence if plunder was in sight. To their heated imagination, in this world of wonders mountains gleamed with jewels and rivers were bedded with gold. With every breath the conquerors drew they inhaled the spirit of adventure like incense, and a mere tradition among the natives was sufficient to start them upon an exploring expedition. By 1529, only thirty years after the Spaniards first set foot on the main land, they were colonizing the western coast of South America, and it was then that they learned of El Dorado—a story that was to lead them upon a course of murder, robbery, and destruction.

The interior of Columbia, or New Granada as it was called in those days, is an extended plateau or table land, the *Parámo,* at an elevation of 3000 meters or more. It was peopled by Indian tribes, and on it were numerous lakes which were regarded by the Indians as holy places, each of which was presided over by a special god or demon, to whom the natives made offering by throwing into the lake articles of gold, silver, or jewelry, emeralds or other precious stones. Five of these lakes were especial sanctuaries or altars of devotion, the principal one being Gua-

tavita, which became celebrated as the place where the myth of El Dorado originated. This was north of Bogotá, the capital city of Columbia, which was founded by the Spanish in 1538 as *Santa Fe* de Bogotá. A tragedy, the unhappy love story of a legendary princess, gave to this lake the glamor of romance in the eyes of the unromantic but superstitious tribes. To escape punishment for the supposed violation of an inexorable law, the wife of one of their earlier chiefs had thrown herself into the lake of Guatavita, and was transformed into a goddess, who became its divinity.

Besides the Indians of the tribe of Guatavita (the Muyscas), pilgrims came from the communes around to cast their offerings of gold and emeralds into the water.

The Spaniards were not slow in making efforts to retrieve the treasures from the lakes, which they drained or dredged or fished over as far as practicable.

The term "El Dorado" means "the gilded one," and has been employed to designate a South American Indian chief who was "gilded" or covered with gold for a ceremonial occasion. But the term has also been used to indicate a country abounding in gold, and it is not certain which usage is the older. The romantic history that has given a fascination to the name rests chiefly upon several legends, the most generally accepted of which is recorded by Juan Rodriguez Fresle in a history of New Granada, written in 1636.* Other writers, both before and after that date, have given the story in one form or another, but that of Fresle, besides being very circumstantial, comes as near as any to being first-hand information.

The distinguished naturalist and explorer, the late Dr.

* *Conquista I Descubrimiento del Nuevo Reino de Granada de las Indias Occidentales* . . . por Juan Rodriguez Fresle, Bogota, 1859. (For a fuller title of this history and statement of its contents, see "References" at the end of this chapter. D. W. H.)

A. F. A. Bandelier, published in 1893 an account of the legend and of the various expeditions that were made in search of the man and the country of gold, so far as could be gathered from the records up to that time. * Since then, further discoveries and the publication of old documents have thrown some additional light upon the subject, and the *Bulletin of the Pan American Union,* in the numbers from January to June 1912, contains a series of articles by J. A. Mansó, Ph.D., that gives a particularly good summary of information that is now available concerning El Dorado. Dr. Mansó himself thinks that a more complete, authoritative work is a desideratum.

The part of Fresle's history that succinctly relates the legend is as follows: After spending his youth in Spain, the historian returned to America where, among friends he made there, was one

"Don Juan, Cacique and lord of Guatavita, nephew of the king whom the conquistadores found ruling at the time when they conquered that kingdom; he was the direct successor to his uncle, and he narrated to me their traditions and customs.

"He said that at the time when the Spaniards entered upon the discovery and conquest of this kingdom, he was in the course of his fasting preliminary to succeeding his uncle; for among them the heirs were the nephews, sons of the sisters, and this custom has been maintained to the present time; and that when he began this fasting he was of mature age; which fasting and other ceremonies were as follows: It was customary among these natives that he who was to be the successor and heir to the Seigniory or cacique-ship of his uncle, to whom he was heir, had to fast during six years, secluded in a cave which was dedicated and set apart for the purpose, and that in all this time he had to keep aloof from women, must eat no meat, or salt, or pepper, and had to comply with other prohibitions; among these, that during the fast, he was not to see the sun; only at night was he permitted to leave the cave, and see the moon and stars, and he had to return before the sun was visible; and upon the completion of the fasting and ceremonies he was put

* *The Gilded Man (El Dorado)*, by A. F. A. Bandelier, New York, 1893.

in possession of the seigniory or caciqueship, and the first journey that he had to make, was to go to the great lake of Guatavita to make offering and sacrifice to the demon which they held its lord and master. This ceremony of oblation was, that at that lake there was constructed a large raft of rushes, which they prepared and decorated as gorgeously as they could; they put into it four brasiers in which they thereupon burned quantities of moss or gum (*moque*) which is the especial incense of these natives, with turpentine and many and various other perfumes. At that time the lake was deep throughout and navigable for a large boat. On the shore encircling it was a multitude of Indian men and women, bedecked with feathers, jewelry and crowns of gold, with innumerable fires all around, and at the moment when the fumigating began upon the raft the fires on shore were lighted, to such an extent that the smoke obscured the light of day. At the same time they stripped the heir naked and anointed him with a sticky earth and powdered him with gold in dust and fine particles until he was entirely covered with the metal.

"He was then taken upon the raft where preparation had been made for him, and at his feet was put a great pile of gold and emeralds to be offered to his god. There went with him upon the raft a number of the principal chiefs, his subjects, much decorated with feathers, gold crowns, bracelets, nose pendants and gold earrings, each one bearing his offering.

"As the raft left the shore the cornets, pipes, and other instruments struck up, along with a shouting and hurrahing of the people, until the mountains and valleys resounded with the noise; this kept up until the raft reached the middle of the lake, where a flag was raised as a signal for silence. The gilded Indian made his offering by throwing all the gold that had been placed at his feet, into the midst of the lake, and the other caciques that accompanied him did the same; on the completion of which, the flag that had been kept flying during the whole time of the offering, was pulled down, and as the raft set out upon its return to the shore, again the clamor began; the pipes and drums, with many of their native dances; with which ceremony they received the newly elected ruler, and acclaimed him seignior and prince. From this ceremony came the so celebrated name of El Dorado, that has cost so much of life and property." *

* *Conquista I Descubrimiento del Nucvo Reino de Granada, Cap. II.* Fresle was born at Santa Fe de Bogotá in 1566. His father was killed in one of the Spanish expeditions against the Indians and he was taken while a child to Spain. Twelve years later he

The name itself and the expeditions in search of El Dorado originated in a casual and unimposing incident of the conquest.

"This name came, in the first place," continues the historian Fresle, "from Peru. Sebastian Benalcazar, having taken Quito, fell in with an Indian of Bogota who told him that in his (the Indian's) country, when they would make a king, they took him to a large lake and there they completely gilded him or covered him with gold, and with great festivities made him king. Whereupon Don Sebastian exclaimed 'Let us go in search of this Indian *dorado*.'"

After the fatigues of marching and exposure, the officers were ready to indulge in hilarious drinking and revelry, and when they found the wandering Indian, no doubt they baited him freely. They brought him before Benalcazar and plied him with questions concerning portions of the country which they had not yet explored. It is a pretty plain inference from the accounts of the Spanish conquest that the Indian natives soon learned to tell the conquerors such things as these wanted to hear, and the narrators were not restrained by any scruples about the truth, nor did they take any pains to separate knowledge from hearsay. Yet their scruples were quite as strong as those of the Spaniards. It is amazing how greedily the latter swallowed the tales of the ignorant if not unsophisticated natives. The account of this incident with Benalcazar is taken from a volume of elegiacs by the early Spanish poet Castellanos.*

Although some scholars dismiss the story of El Dorado

returned to America. This would have been about 1584. The conquest of Bogotá by Quesada was in 1579. If Fresle received Don Juan's narrative within two or three years after his return, say in 1586 or 1587, the dates would make it possible that the Indian might have been a young man of twenty or over at the time of the conquest, which would make him between 65 and 70 at the time of the narration. It is quite possible, therefore, that the story is really from the lips of a contemporary. D. W. H.

* *Elegias de Varones Ilustres de Indias;* Parte III, *Elegia a Benalcazar,* Canto II. Por Juan de Castellanos.

as altogether a fable, there is a good deal of evidence in its favor. Among articles found in the lake or lagune of Siecha, in 1856, was one of gold having a base like a mat of rushes, on which was a central figure, surrounded by nine others, with various paraphernalia. This has been supposed to represent the cacique of the ceremony described.

In countries further to the north, something of the story was known before its telling at Quito, for as early as 1529, says Bandelier, in Coro, Venezuela, the Spaniards became cognizant of a story that was current among the Indians of that section, "of a tribe dwelling in the mountains to the south with whom gold was so abundant that they powdered the whole body of their chief with it." In that year the first formal expedition in search of the gilded man was undertaken, by the Governor of Venezuela, a German leader, Dalfinger. His campaign was sanguinary and cruel to the natives, but he died without succeeding in his search.

Benalcazar (or Belalcazar), mentioned in the Elegiacs of Castellanos, was a leader of Francisco Pizarro's forces in the conquest of Peru, who had advanced as far as Quito in 1535, when the story of the wandering Indian incited him and his soldiers to go in quest of the Dorado. His campaign lasted until 1539 and resulted in the conquest of Cundinamarca, the province containing the high tableland of Bogotá in which was the lake of Guatavita, and which was the country of the *Muyscas*. Much booty in gold was obtained but no *hombre dorado*. The fame of the gilded man had spread into other countries occupied by the Spaniards and Benalcazar's expedition was hardly at an end before another was on foot (in 1541) under Gonzalo Pizarro, half brother to Francisco, the leader celebrated for his cruelties as Governor of Peru.

The story of the gilded man has many variants, most of them providing for the removal of the golden garb from the body of the chief, either by his plunging into the

lake or by some other form of ablution. To Gonzalo Pizarro the legend was of "a great prince who was always covered with powdered gold so that from head to foot he resembled a figure of gold wrought by the hand of a most beneficent artificer (*"una figura d'oro lavorata di mano d'un buonissimo orifice"*). The powdered gold is fixed on the body by means of an odoriferous resin; but this kind of garment would be uneasy to him while he slept, the prince washes himself every evening, and is gilded anew in the morning, which proves that the empire of *el Dorado* is infinitely rich in mines."* It was not long before the subject became a breeder of strife among the Spanish leaders themselves, who had become crazed by their lust for gold; and when the term "El Dorado" came to signify not merely a gilded man, but the country to which he belonged, which was believed to be fabulously rich in gold, no doubt wild tales inflamed the minds of the rank and file of the armies that went in search of the man or his country, and the use of the term in that sense became more common than in its proper meaning.

How many of the tales told by the natives were traps to lure the Spaniards to destruction cannot be known. The "civilizing" process applied to them by the invaders was not of a kind to make them hospitable, and they seemed to lose few opportunities to represent to their Spanish friends that El Dorado was easy of access and not very remote, but in its changing form and ever-shifting locality it became a phantom which they pursued in vain.

So far as concerned the discovery of El Dorado, Pizarro's expedition was fruitless, and after nearly a year and a half of indescribable hardships and privations, the few survivors of his army returned to Quito. But they had added much to the knowledge of the interior of the country and its resources. This was the exploration of the land of cinnamon.

* From a letter of Oviedo to Cardinal Bembo. Humboldt, *Personal Narrative,* Vol. 5, p. 815.

That indeed was the ostensible purpose for which it was undertaken, but a letter sent to Spain in 1542 revealed the fact that Pizarro had the cinnamon less in mind than a gilded uncivilized chieftain. The story as Pizarro had it, says Schumacher, was "the first genuine Dorado-legend. It runs quite differently from all the Guatavita versions and everything connected with them." * This expedition was followed by several others from Bogotá or other localities in the western portion of the continent, until as late as 1579, always instigated by some wonderful story by Indians or irresponsible travelers, which was usually more or less fortified by specimens of gold, or natural curiosities. In 1560 came Orsua's expedition to the Omaguas which Humboldt characterized as the most dramatic episode in the history of the Spanish conquests. It met the fate of its predecessors in failure to find the country of gold, and in loss of life and money.

Undeterred by the record of disastrous attempts to find El Dorado, the famous conquistador Ximenes de Quesada set out from Bogotá in 1579 with a formidable force of Spanish soldiers, Indians, negroes, horses and other animals, and a full equipment of supplies for a long campaign. It was perhaps the most famous of all the expeditions undertaken by the Spaniards in this romantic quest and, as in the case of its predecessors, after three years of wretched experience of almost every form of misery that could come from hunger, disease, exposure, and conflicts with hostile savages, the broken creatures constituting the remnant of the army made their way back to Bogotá.

While these efforts of the Spaniards were in progress from the west, the story with its magic power was per-

* *El Dorado; Aus der Geschichte der ersten Amerikanischen Entdeckungs-Reisen. Mittheilungen der Geographischen Gesellschaft in Hamburg.* 1889. Schumacher rejects the whole story of El Dorado as a fable, and the prince as a myth.

meating the northern and eastern districts. In 1584 Antonio de Berrio directed an expedition to the valley of Barraguan (Orinoco). It failed after three years of hardship, and the survivors returned to their homes in New Granada. Soon afterwards he renewed the attempt. Berrio was fed to repletion with the most extravagant reports, and he was confident the Gilded King was in the city of Manoa which he thought was located upon a large lake at the upper reaches of the Orinoco. The Spaniards were simply crazed by the tales of the natives, and enthusiasm ran so high over this venture which was under the military leadership of Domingo De Vera that, as Dr. Manso says, "Spain was El Dorado mad. The craze assumed such proportions that an old chronicler avers that it would then have been possible to depopulate La Mancha and Estramadura and the Kingdoms of Toledo and Castile." * Money flowed in from all sources—from the court, from nobles, and from the private purses of people in humbler ranks, and De Vera sailed from San Lucar in February 1595 with a fleet and company twenty times as great as that with which Columbus discovered America. They failed miserably, encountering incessant disaster from the natives, from disease, and from the climate.

And now, in addition to the long list of celebrated Spanish leaders, came an Englishman no less renowned than they for his daring, his chivalry, his brilliancy and his polish—the romantic courtier Sir Walter Raleigh. Of the many narratives connected with the search for this elusive country of gold, one of the most extraordinary is that of Raleigh's discovery of Guiana, and his exploration of the Orinoco River, in 1595. † This account gives many details of the

* "The Quest of El Dorado," *Bulletin of the Pan American Union,* April, 1912.

† *The Discoverie of the large, rich and bewtiful Empire of Guiana, etc. Performed in the Yeare 1595,* by Sir W. Ralegh.

city of Manoa, to which the legend by this time had transferred the location of El Dorado. The Hakluyt Society of London reprinted the original record of this voyage, with a scholarly introduction by the distinguished traveler and geographer, Sir Robert Schomburgk. Raleigh's own account was so full of improbabilities and extravagances as to be greatly discredited from the first, though the expedition was wonderful enough to rank high among the great achievements of that age of discovery. The parts relating to the location of the gilded chief are best told in the words of the author of the narrative, and of its editor. Says the latter (Schomburgk),

"When, after fruitless searches in New Granada, the locality of the fable was transferred to Guiana, the whole province was designated by the name of El Dorado, but the lake or laguna, surrounded by auriferous mountains, continued a necessary accompaniment to the shifting fable. . . . When, therefore, the attention of adventurers was, at the close of the sixteenth century, attracted to Guiana as the spot where El Dorado was situated, the name of the river Parima * and the inundations of the flat country and savannahs . . . gave rise to the fable of the White Sea, or Laguna del Parima or Dorado." (Introduction, pp. 50, 51.)

Says Sir Walter's narrative, ". . . as I haue beene assured by such of the *Spanyardes* as haue seene *Manoa* the imperiall Citie of *Guiana,* which the *Spanyardes* cal *el Dorado,* that for the greatnes, for the riches, and for the excellent seate, it farre exceedeth any of the world, at least of so much of the world as is known to the Spanish nation, it is founded upon a lake of salt water of 200 leagues long like vnto *mare caspiu*" (p. 13). "The first that ever saw Manoa was Johannes Martines" (Juan Martinez).

Then follows a detailed story told by *Martynes* and said to be deposited in the *Chauncery of San Juan de Puerto Rico,* relating how he came to *Manoa,* his reception there, and his way of living for seven months in this wonderful city.

"This *Martynes,*" continues Sir Walter's narrative, "was he that christned the citie of *Manoa* by the name of *El Dorado,* and as

* Meaning "great water"—Humboldt.

Berreo informed me vpon that occasion; . . . at the times of their solemne feasts when the Emperor carrowseth with his Captayns, tributories, and gouernors; the manner is thus. All those that pledge him are first stripped naked, and their bodyes annointed al ouer with a kinde of white *Balsamum* (by them called Curcai) of which there is great plenty and yet very deare amongst them, and it is of al other the most pretious, whereof we haue had good experience; when they are annointed al ouer, certaine seruants of the Emperor hauing prepared gold made into fine powder blow it thorow hollow canes upon their naked bodies, vntill they be al shining from the foote to the head and in this sort they sit drinking by twenties and hundreds and continue in drunkenness sometimes sixe or seuen daies togither" (pp. 20, 21).

This story has been regarded as pure invention, but Humboldt (*Personal Narrative*) thinks there is sufficient evidence to show that Martinez had been at Santa Fé de Bogotá, and learned of the ceremonies at Lake Guatavita, from which his fertile brain evolved the wonderful narrative of Manoa.

Raleigh's account of his "voyage" contains graphic descriptions of marvelous creatures—animals and birds; strangely misshapen, grotesque, human beings; and also curious plants, some of which descriptions are true while others are repeated from the tales told the voyagers, and are the wildest products of imagination. Among other wonders he describes warlike women, the American Amazons, from whom the Amazon River is named. The narrative has been scored and derided by critics, and Raleigh has been ridiculed as the most gullible of men, but it really looks as if he knew what he was doing and, having had the most outrageous yarns foisted upon him, was resolved to show what he himself could do in the same way, and to give every narrator "a Roland for his Oliver." A sixteenth century Munchausen, antedating the Baron by just two hundred years, Raleigh was probably enough of a humorist for that, and anyhow, in those days a traveler

was accorded as much latitude in his tales as a fisherman today.

This expedition was made in the same year as that of De Vera, mentioned above, and, so far as the golden goal was concerned, was as bootless. Raleigh returned to England but clung to his dream of El Dorado. The intrigues of politics that kept him a prisoner in the Tower of London for twelve years could not extinguish the ardor of his desire to discover the city of gold, and in 1617, twenty-one years after his first disastrous attempt, he engaged in another and final effort—futile like all the others, and resulting for him only in being charged before the English court with piracy, and ignominiously executed. This was the last of what might be called major expeditions in the quest of El Dorado, though there were many minor ones succeeding as well as preceding it.

Besides the part which this quest has taken in the romance of history it has furnished the theme for poetry and fiction. It is a delightful subject for romantic literature, and one of the best romances of the kind appeared recently from the pen of Clifford Smyth.* The author, who had been United States Consul at Cartagena, Columbia, had inbibed the spirit of the story in its home land, and tells it with the skill of a sympathetic master, while the interest of the reader is enlisted in advance by a most appreciative introduction by Richard Le Gallienne.

The search for the gold of this legend nowadays belongs with that for Captain Kidd's treasure, the "pieces of eight," and the Spanish doubloons; with the cargoes of the precious metal that went to the bottom with the plate-fleet galleons that were to transport them to the mother country; with all, in short, that goes to make the romantic atmosphere so long associated with the Spanish Main.

* *The Gilded Man. A Romance of the Andes.*

Dr. Cook's Reputed Attainment of the North Pole

With the era of exploration that was ushered in by Columbus' first transatlantic voyage began the attempts to reach the Pacific Ocean from the Atlantic, or at all events to continue around the world, by passing north of the American continent instead of coming away to the south, around Cape Horn. In geographic parlance the way thus sought was called "the northwest passage." If the great arctic ocean was open water, the passage might perchance carry the voyager directly over the north pole, and so the exploration of those northern waters incidentally involved the attainment of the pole. For four hundred years was that quest continued, with a marvelous record of endurance, skill and heroism; with meager additions to our ethnographic knowledge; with an actual navigation through a continuous northwest passage that is sometimes open, but is not practicable as a commercial route; and with a diversion of the interest in this passage to an ambition to attain the pole itself—an ambition resting largely upon sentiment, but shared by men of various nationalities.

"Farthest North" has steadily receded into higher and higher latitudes; the arctic regions unvisited have shrunk until, in 1881, they lay within a zone that at one point was only 6° 36′ or 396 geographic miles from the pole. This point was reached by General Adolphus W. Greely, in an expedition of tragic experiences. The expeditions of Robert E. Peary, between 1898 and 1906, carried that explorer to a point only 169 miles south of the pole. His expedition of 1908–1909 was the final one, in which, by a dash of 133 miles from their most northern camp, he and one companion, Matt Henson, reached the pole and planted there the stars and stripes.

So the story goes, and national governments and learned societies have proclaimed their confidence in Admiral Peary's achievement, and have loaded him with honors in recognition

of it: but interwoven with this story is another story, one of the strangest in the annals of geographic discovery, and the two make a fabric that is soiled by doubt and suspicion; discolored by charges and countercharges of deception; and stained by reproaches and recriminations. If it is true that "nothing is settled until it is settled right," there is needed more and better evidence—at any rate corroborative evidence—to settle this controversy than has yet been produced. It is that "other story" that we have to tell here. Admiral Peary and another explorer were rival claimants to the honor of first reaching the pole; both had partisans, and not a claim for credit, not an accusation of misdoing was made from either side that did not encounter a "me too" or a *tu quoque* from the other. The dispute went so far as to question not only who first reached the pole, but whether either reached it at all. The truth, if it is ever known, will have to be drawn from the bottom of a well that is uncommonly deep.

Dr. Frederick A. Cook of Brooklyn, N. Y., had won a wide reputation as an explorer by participating in The Belgian Antarctic Expedition, 1898–1899; by conducting a party in an attempt to reach the summit of Mt. McKinley in Alaska in 1903 and again in 1906; and by serving as medical officer in Lieutenant Peary's arctic expedition, 1901–1902.

On July 3, 1907, he set out upon a trip into northern regions from Gloucester, Mass., on a staunch yacht, *The John R. Bradley*. This boat was named in honor of Mr. John R. Bradley of New York, who was responsible for its outfitting and was sponsor of the trip. The yacht was captained by Robert Bartlett, an experienced officer who had commanded Peary's ship *The Roosevelt* in 1906 and in 1908 again took command of *The Roosevelt* which had been restored after the battering she had undergone, and was then to carry Commander Peary and his party on their

celebrated final voyage to the pole. On the *Bradley* Dr. Cook was ostensibly a guest of the owner, and the trip was ostensibly an excursion in quest of big game in the northern part of Greenland.

In arctic expeditions, the ship never goes as far north as her crew. She can only advance through open water and is sure to become icebound eventually. The remainder of the traveling is over ice, chiefly by sledges. With these drawn by the hardy Eskimo dogs, material is transported ahead and a camp is established and provisioned; from this another station is fitted out further on and when the last feasible camp is thus established, further progress, for a few days longer toward the pole, is made by limited parties in sledges or on foot. These have to clamber over rough ice, and at times encounter leads of open water with ice floes, and their progress is very uncertain. Sometimes, when they are on a large detached floe, they are carried by it far south of the point from which they had set out earlier in the day. Carrying enough material for, say, two weeks, they may advance for a week and then must return. Some days almost no progress is made—at times sixty miles may be made in a day; an average of twenty miles a day through a period of several weeks is making good speed. The party of explorers is always becoming smaller in number, and the last spurt is usually made by one or two members, encumbered by no impedimenta that they dare to dispense with.

Dr. Cook's Expedition

The *Bradley* and her party made their way northward to Annooktok, near the well-known Eskimo station Etah, and there landed their stores and camp material late in August 1907, and from there Captain Bartlett and the rest of the party except Dr. Cook returned to the States.

Dr. Cook spent some months at Annooktok in collecting dogs, sledges, and native assistants, until February 18, 1908,

when he set out with a party of eleven men in all, eleven heavily loaded sledges, and one hundred and three dogs. By

Map Showing the Disputed Marches of Cook and Peary.

the middle of March they arrived at the northern end of Nansen's Sound, where they established a base camp. (See map.)

On March 18th, with four picked Eskimos and a considerable outfit he pushed forward, and in three days, by marches of 26, 21, and 16, or in all sixty-three miles, they reached Lat. 82° 28′. On the 21st, after sending back two of his faithful Eskimos, and retaining two other young men, Ah-we-lah and E-took-i-shook, he started upon a sustained, direct attempt to reach the pole, 452 miles distant. He had with him twenty-six dogs and two sledges, laden with a small folding canvas boat, silk tent, sextant, compasses, chronometers, pedometer, watch, chart and map materials, barometer, thermometers, etc. There is the testimony of Mr. Bradley and other credible witnesses that the yacht took an equipment of good instruments, and there is no reasonable doubt that Dr. Cook took as many of them with him as was proper, so that supposedly he lacked nothing essential in the last stages of his journey northward. According to his account, from the 21st of March his course was almost due north on the meridian of about 95° W. On March 30th he was in Lat. 84° 17′, Lon. 96° 36′, having made an average progress for nine days of about fifteen miles per day; April 14th, Lat. 88° 21′, Lon. 95° 52′, averaging about eleven miles a day for fifteen days; April 21st, Lat. 89° 59′ 46″—a quarter of a mile to go!—having averaged about fifteen miles a day during the last week. Within all reasonable demand he was then at the pole. It is not humanly possible to be certain of the latitude within so small a margin of error, and to be at any point within a mile of the actual terminus of the earth's axis would readily be accepted as reaching it. On the map, the broken line of heavy dashes shows the alleged course from Annooktok to Nansen's Sound, and thence to the pole itself. The Eskimos, says Dr. Cook, were told that they had found the "big nail" and were elated. Two days were spent here, taking observations and making notes; the American flag was raised and photographed, then taken down by the explorer

to be brought home with him; but he placed a smaller flag and written memoranda of his achievement in a metal cylinder which he buried in the ice and left to an unknown fate:—to be resurrected, perchance, at some uncertain future time; or to be carried by shifting currents to other regions; or to sink forever from human sight.

On April 23d, the three started back for Axel Heiberg Land. The return was far more arduous than the advance. Fogs and harsh weather made traveling difficult, slow, and dangerous; not until May 24th was the weather clear enough to permit noon observation by the sun. They had then reached Lat. 84°, Lon. 97° W., having come at least 360 miles in thirty-one days, and were far west of where they ought to have been. Not clear as to their course, for twenty-one days more through fog, against fatigue, and facing famine, they struggled until June 14th when, worn out and almost in despair, they reached Amund Ringnes Land where, after six more days of hardship, they succeeded in killing a bear and a seal, on the 20th.

With only a few remnants of his outfit, with ten scrawny dogs, a dilapidated sledge, and a frail, collapsible boat to help them over water passages, he and his two companions hunted, struggled, and starved as they slowly and painfully made their way back. They wintered miserably in a dug-out on the shore of Jones Sound, more than a hundred miles from Cape Sabine. It was in late April or early May, 1909, that, in a last effort, Cook and his companions made a spurt that they hoped would bring them to Annooktok. Eight miles from that village, out on the ice, he was found by Mr. Harry Whitney of New Haven, who had come north upon an arctic hunting trip—the only white man whom he had looked upon for fifteen months. After the long arctic night—such a night of isolation and privation—could any man tell a coherent and unimpeachable story of his experiences? There are those who doubt the possibility of it, much more the probability.

The forlorn party were promptly taken to Etah, and Cook told Whitney of his success. But he also learned a good deal that was disconcerting in regard to the movements of Commander Peary. *The Roosevelt,* bearing the party of the latter, had been at Etah, and Peary had installed a portion of his men in the camp at Annooktok where Cook had left much material. According to Cook's narrative, the interlopers had made free use of this and had to be ousted by him.

Mr. Whitney expected to rejoin Peary's party on *The Roosevelt* on their return, and Cook asked him to confine his account of his (Cook's) achievements to the statement by Cook himself that "he had got further north than Peary had ever reached in any of his expeditions, and that *he had accomplished everything he went north for";* a request with which Mr. Whitney complied scrupulously. Cook had left his instruments and a package of memoranda behind on the last day of his march, and Mr. Whitney agreed to go for them and bring them home with him, as Cook was anxious to press on with no more delay than was absolutely necessary. Disappointed in being unable to get a ship at Etah, with his two faithful Eskimos he made his way laboriously southward to Upernavik, reaching that place in May 1909. Here, later in the summer, he boarded the Danish mail steamer *The Hans Egede,* bound for Copenhagen, and was happy in the opportunity thus offered him to return to civilization. The first port they reached from which to send a message was Lerwick, in the Shetland Islands, where they arrived on September 1st, 1909, and from there Cook cabled to Copenhagen, announcing his success. The news was immediately spread, and the world was thrilled by it.

The Hans Egede reached Copenhagen on September 4th, where Dr. Cook was welcomed by representatives of the Danish Government, and by the American Minister, Mr.

M. F. Egan. His story was unhesitatingly credited, he was banqueted and toasted, and congratulations and plaudits abounded.

Commander Peary's Expedition

While Cook, avoiding publicity, was making his way into the arctic regions, *The Roosevelt* was being overhauled and refitted under the auspices of the Peary Arctic Club. Commanded by Robert E. Peary, captained by Robert A. Bartlett, with a select scientific staff, this vessel had set out upon what its company all hoped and comfidently expected would be a final expedition to the Pole. Nearly every member of the party had shared in one or more arctic voyages, and was experienced in this mode of life. *The Roosevelt* reached Etah early in August 1908, and on the 8th of that month, following prearranged plans, the expedition left there for Cape Sheridan (see map), where they arrived in February 1909. This was as far as the ship was to go and here, in Lat. 83°, Peary made his base camp.

Having sent Captain Bartlett and others ahead a week earlier, Commander Peary left the ship Feb. 22d, with two Eskimos, two sledges, and sixteen dogs. There were now 7 members of the expedition, 19 Eskimos, 140 dogs, and 28 sledges "in the field for northern work." All were to meet at Cape Columbia, about ninety miles from Cape Sheridan, and from there the real push north was to begin. After various mishaps and delays, they got away from this point March 1st. By sledges, with a selected party Peary reached Lat. 86° on March 23d, where he crossed his track of 1906, and pushing on, by the 28th he was at Lat. 87° 47′, Camp Bartlett. At this point, one hundred and thirty-three miles from their goal, the Commander sent Captain Bartlett and others back to their camp, and himself and one companion, the negro Matthew Henson who had long been his personal attendant, began their final spurt with four Eskimos, two sledges, and forty dogs. Though they were

stripped for the running, with difficulty they made from fifteen to thirty miles a day, reaching, on April 2d, 88°; April 4th, 89°; April 6th, THE POLE! A year, lacking fifteen days, from the date at which Dr. Cook claimed to have stood upon the same spot; but neither Peary nor Henson had any suspicion of the cruel irony that lay beneath their rejoicing, and that later was to embitter their success. Here they remained until the next day, exalting the flag, taking observations, and making notes.

There were no heroics.

At a complimentary dinner in New York the following October, immediately upon the return of the ship's company, Henson related that the Commander called him to his side and said "Well, what do you think we ought to do next? An' I said, well, now we're here I guess we better see about gettin' back!" Henson was apparently less concerned about the nature of their achievement than about the practical details of performing it.

They deposited in the ice a glass bottle containing records and a strip of the flag, and set out upon their return April 7th, and on April 9th they were back at Camp Bartlett, Lat. 87° 47′, having come 133 miles in a little more than two days or sixty to seventy miles per day, retracing in two days the course that had required ten days for the advance. They reached Cape Columbia April 23d; and after two more "marches" of forty-five miles each, they joined Captain Bartlett and the ship at Cape Sheridan. Professor Marvin had been drowned when the supporting party were coming back after taking leave of Peary and Henson. It was a long time before they could take the ship out, but on July 18th, they all turned their faces homeward and *The Roosevelt* steamed for Etah, where they arrived on August 17th. Here they picked up Mr. Whitney who remained with them until they met, near North Star Bay, the *Jeanie* which had been sent north for Whitney and was also bringing coal

for *The Roosevelt.* Whitney transferred to the *Jeanie* and *The Roosevelt* proceeded on her way southward. While at Etah, Whitney told the Peary party of his encounter with Dr. Cook, and of his custody of Cook's belongings, but did not feel at liberty to say anything more about Cook's movements than the statement made on p. 185. Although he was received as a passenger on *The Roosevelt,* he was not permitted to bring back on the ship any of Dr. Cook's things, so he cached them in the rocks at Etah. They included the flag, some instruments, and memoranda. Cook had long before made duplicate notes, and had taken a copy of them with him.

Not until Peary's party came into telegraphic communication with the United States, in September, did they learn definitely that their attainment of the Pole had been anticipated in the statements of Dr. Cook.

They had no opportunity to send their news home until September 7th, when they reached Indian Harbor, Labrador. Peary immediately dispatched a telegram, relayed by wireless, to the *New York Times:*

"I have the pole, April 6. Expect arrive Chateau Bay, September 7. Secure control wire for me there and arrange expedite transmission big story. Peary."

This was followed by various other stirring messages from other members of the party as well as himself.

And now the story resumes connection with Dr. Cook.

Immediately upon his arrival at Copenhagen, September 1909, this explorer had cabled news of his feat to the *New York Herald,* and a special message with the same announcement to the President, William H. Taft. On the evening of the seventh, he was dining with an enthusiastic body of newspaper correspondents, university men, and state and city officials, when the news of Peary's discovery arrived, upon which Dr. Cook expressed especial pleasure, as Peary's observations and reports would confirm his own. He came

on to New York as early as practicable, and here he was received enthusiastically; civic honors were heaped upon him, and a great complimentary banquet was accorded him. He was the hero of the hour. He was disappointed and chagrined, however, by the refusal of Peary to permit the bringing back of his data, and soon became sensible of the storm of opposition, censure, and criticism that was brewing.

The Controversy

Of all arctic explorers, Commander Peary had been most persistent. For more than twenty years he had faced the hardships of life in the far north in repeated expeditions, undeterred by defeat and undismayed by failure; ever advancing beyond former limits, and at last realizing the goal of his ambition. Confident that the credit of being the very first to reach the apex of the globe was his, it was more than galling to find that credit claimed by another. Doubt and ill feeling were inevitable. Possibly the honor might quietly have rested upon both, but for an intense partisanship that at once developed, and controversy grew warm as each party accused the other of robbery. Even so, a dispute between individuals would not have made so much stir as did this if it had been confined to the disputants, but the press throughout the country took an active part in it, lining up on opposite sides, bandying arguments, criticism, and jests; never amiable, not often dignified, seldom courteous. Of the New York dailies the *Herald* staunchly supported Cook through thick and thin, and the *Times* championed Peary and his claims. With such contestants it became a battle of giants.

The University of Copenhagen had taken a friendly interest in Dr. Cook and his work, and he submitted his records to the officers of that institution to pass upon his claims to the honor of the discovery. Commander Peary's were submitted to a special committee of the National

Geographic Society. Before either of these committees made its report, the discussion had gone far away from the point in question, which was simply whether either explorer reached the pole. The verdict depended, in the case of Cook, upon the actual whereabouts of that explorer in the few weeks immediately after the twenty-first of March, 1908, when he reached Lat. 82° 28′ N.; in the case of Peary, upon his whereabouts during the four weeks following March 28, 1909, when he reached Camp Bartlett in Lat. 87° 47′ and Captain Bartlett and companions started back to the ship. Dr. Cook went *somewhere* with only two young Eskimos for companions; Commander Peary went *somewhere* with only Matt Henson and four Eskimos for companions. Sir Philip Gibbs in *The World's Work* for March, 1923, tells how he discovered and exposed the falsity of Cook's claims, but throws no light on this particular part of Cook's journeying. It is easy to believe that Cook himself did not know where he was—but he probably knew as much about it as anybody else knows. The only reason for believing that either explorer reached the Pole is that he said he did. There is not now and there never has been any other evidence of the fact unless it should be material which they left there. The evidence of their geographical position consists wholly in the observations recorded by each officer; and the account of their doings is given in the diaries of the leaders, in Henson's diary, and in the oral testimony of the two whites, the black, and the six Eskimos. As no one but the two leaders had the means of taking scientific observations, even supposing the others had been competent to do so, the records of the explorers are the sole evidence of their positions. No amount of such evidence, even if it located them accurately at the Pole, would prove that they were there, and inaccurate observations locating them elsewhere would not prove that they had not reached the Pole. A remarkable thing about this whole adventure is that, independently

of each other, both explorers should have elected to make the final reach without a scientific companion and to place their story before the world uncorroborated. Only corroborative evidence could be conclusive proof. So the dispute soon degenerated into efforts to impugn the honesty of the explorers.

The *New York Times* produced affidavits ("bought," said Cook's defenders) that Cook had engaged two ship's officers in Brooklyn to fake records for him of observations during the time in question; Edward Barrill made affidavit that he and Cook had not gone to the top of Mt. McKinley as Cook had published, though that had no direct relation to the North Pole—"subornation" was the retort; the two Eskimos Ah-we-lah and E-took-i-shook were brought to Washington where they traced on a map the course they took when they were with Cook, a course that did not go north of 82° 48′—"a clear case," said Dr. Cook, "of fidelity to their promise to me not to tell Peary where they had gone." Evidence was brought forward to show that Cook had described some places and things differently from the way some other traveler had described them, so Cook's statements were false! Nothing was omitted that could impeach his credibility.

In reply much of the same sort was uttered regarding Peary; to offset the failure of the Eskimos to support Dr. Cook's narrative, it was said that Henson's diary did not harmonize with Peary's; there were discrepancies that amounted to contradictions; there was a great deal that was directed against the honesty and capability of the explorers but had virtually nothing to do with the question at issue. The criticisms of the observations themselves showed that "expert" testimony was of little more value here than in an ordinary court, since it could be arrayed in equal force on either side.

Up to this time the reputations of both men had been

untarnished, and both had won many friends and admirers, though Peary had been criticized as temperamentally harsh and overbearing, while the opposite characteristics in Cook attracted friends to him.

The report of the investigating committee of the University of Copenhagen was to the effect that

"The evidence submitted did not contain proof that Dr. Cook reached the Pole, nor is there any decisive proof to the contrary."

This was generally viewed as the only verdict that could be expected, though outside offers of proof to that same "contrary" were unstinted and cocksure.

October 20th, 1909, the Committee for the National Geographic Society reported:

"Commander Peary has submitted to this sub-committee his original journal and records of observations, together with all his instruments and apparatus and certain of the most important of the scientific results of his expedition. These have been carefully examined by your sub-committee, and they are unanimously of the opinion that Commander Peary reached the North Pole on April 6th, 1909."

They added a special tribute to his skill in organizing and conducting the expedition, and declared him "worthy of the highest honors that the National Geographic Society can bestow on him." The signers of this report constituted the committee of investigation and were Henry Gannett, Chairman; Rear Admiral C. M. Chester; and O. H. Tittman, Superintendent of the U. S. Coast and Geodetic Survey.

Cook's supporters regarded this as a "packed" committee, so partial that their verdict was a foregone conclusion regardless of the evidence that might get before them. The investigation and preliminaries upon which the committee based their report were ridiculed and belittled sufficiently to impair the value of the report. The matter was also thrashed out in Congress, where national recognition of Peary's claim to honor was discussed. From the testimony offered in all these inquiries, and that coming from other

sources, it seemed that a considerable proportion of the participants in the discussion who had been actual travelers and explorers were disposed to accept Cook's record as of facts, while much of the criticism unfavorable to him was from stay-at-homes, able and learned enough men, perhaps, but sneeringly dubbed "arm-chair critics." Among arctic and antarctic explorers favoring Cook were General A. W. Greely, Admiral W. S. Schley, Captain Evelyn Baldwin, Knud Rasmussen, Captain Otto Sverdrup, Captain Roald Amundsen—all of unimpeachable character and competency; and there were not lacking men of science who were widely traveled, of large attainments, of high standing, and with no axe to grind, who took the same side. Of the above named Rasmussen and one or two others subsequently withdrew or qualified their indorsement of Cook's claims. There were able judges who thought that the Pole was actually reached by both explorers, but the acceptance of that idea by Peary would have been an acknowledgment that he had been anticipated by a year, and would have deprived him of nearly all the satisfaction with which he contemplated the fruition of his life-long striving.

The latest evidence bearing directly upon the Cook-Peary dispute is a letter written by Donald B. MacMillan to the editor of the *Geographical Review,* from Boston, Mass., December 31, 1917. Mr. MacMillan was a member of the scientific staff on *The Roosevelt,* 1908–1909, and subsequently (1911–1912) led an expedition to seek for Crocker Land, and during a portion of the time had with him the two Eskimo boys that had been Cook's companions. According to their story, Cook and eight Eskimos camped at the northern end of Axel Heiberg Island, five miles east of Cape Thomas Hubbard.

"Four Eskimos returned to Etah. Four Eskimos accompanied Dr. Cook during the first day's march on the Polar Sea, a march of about twelve miles. Upon the completion of the snow-house,

two Eskimos returned to land, leaving E-took-a-shoo and Ah-pellah ('E-tuk-i-shook' and 'Ah-we-lah' in Dr. Cook's book) alone with Dr. Cook.

"Dr Cook and his two Eskimo boys did not proceed beyond this point, which is about 500 miles from the pole." *

Mr. MacMillan's letter further relates in detail the subsequent travels of the Eskimos with Dr. Cook until they got back to Etah; and recognizing many of the pictures in Dr. Cook's book, they not only denied the legends which the photographs bore, but told specifically where they had been taken, and what they really depicted—flatly contradicting Dr. Cook's record.

In a long list of deservedly famous arctic explorers, Peary will undoubtedly go down in history as one of the greatest; Cook, discredited and under a cloud from which he may never emerge, can only be vindicated, if at all, by a future that holds out but little hope. Probably there are very few people who do not wish that Peary's reported discovery of the Pole may be true, certainly there are many who believe it is a fact, none can know that it is so. If, as both Cook and Peary reported, the spot which they located as the pole was on an extended ice-floe, then that region is not land but sea; anything deposited there by them would be carried by the drifting floe, perhaps many leagues, and subsequent navigators who might attain the pole would seek for the deposit in vain; even such material which might be conclusive evidence of a positive character would have disappeared. On the other hand if it were found at the pole it might have drifted there from a point far distant.

Symmes' Theory of Concentric Spheres

Before the frozen barriers of the north had yielded to the march of civilization, and more than a score of years before

* *The Geographical Review,* February, 1918.

arctic exploration had placed its stamp of tragedy upon the ill-fated expedition of Sir John Franklin, public curiosity concerning polar regions was aroused by the following

"CIRCULAR.

Light giveth light to light discover—*ad ifinitum.*

St. Louis, Missouri Territory,
North America,
April 10, A. D. 1818.

To all the World:

I declare the earth is hollow, and habitable within; containing a number of solid concentric spheres, one within the other, and that it is open at the poles twelve or sixteen degrees. I pledge my life in support of this truth, and am ready to explore the hollow, if the world will support and aid me in the undertaking.

John Cleve Symmes
Of Ohio, late Captain of Infantry.

N. B.—I have ready for the press a treatise on the principles of matter, wherein I show proof of the above positions. . . . I ask one hundred brave companions, well equipped, to start from Siberia, in the fall season, with reindeer and sleighs, on the ice of the frozen sea; I engage we find a warm and rich land, stocked with thrifty vegetables and animals, if not men, on reaching one degree northward of latitude 82; we will return in the succeeding spring. J. C. S."

This novel theory created much amusement, like that which first greeted the idea that the earth was a globe with people living on the under as well as the upper side of it. The circular was widely distributed throughout the world, and "Symmes' Hole" became a byword. The breeziness and audacity of the announcement gave it a freshness that belonged to a new country, for when it appeared, the westward course of empire had scarcely passed the Mississippi, Ohio and Kentucky were still "out west," and Missouri had not attained to the dignity of statehood. Its author, John Cleve Symmes, Captain in U. S. Army, had served with distinction in the war of 1812, retired from the army upon its disbandment in 1816, and engaged in business in St.

Louis, where he began his efforts to establish his *Theory of Concentric Spheres, Polar Voids, and Open Poles.* The subject completely obsessed him. The more it was questioned the more he cudgeled his brain to give his ideas plausible form, until he had evolved an extraordinary plan of the structure of the earth in its interior—a plan that was idealistic in every detail. He lectured extensively and made converts who helped to spread his views. Popular entertainments were held to raise funds in support of the project. He petitioned Congress in 1822 and 1823, and the General Assembly of the State of Ohio in 1824 for governmental support, but in each instance the subject was quietly tabled, and nothing further came of it at the hands of legislators. Under his arduous labors in traveling and lecturing Captain Symmes' health broke down and he returned to his home in Hamilton, Ohio, where he died in 1829.

His theory and the grounds upon which he supported it are given in a pamphlet issued in 1878 by his son, Americus Symmes. Some of these grounds were pieces of information from travelers, of which the accuracy was by no means assured—but the strongest was the fact that the temperature above latitude 82° N. was higher and the climate milder than below that latitude. The evidence of this in Captain Symmes' day was the statement of Esquimaux and arctic explorers that in certain seasons there was abundance of arctic animals which came *from the north,* and on the approach of severe weather the arctic animals and fowls all migrated *northwards.* He added to this varied arguments based upon the astronomy of that day, which he could manipulate in favor of his views, but it was rather slight for such an extraordinary geodetic theory.

"Each sphere has an intermediate cavity or *midplane-space* . . . situated between the convex and concave surfaces of the sphere, filled with a very light and elastic fluid. . . . The sphere, in many parts of the unfathomable ocean, are believed to be water quite through

from the concave or the convex surface to the great mid-plane space, and probably the earthy or solid matter of the sphere may in many places extend quite through from one surface to the other; tending like ribs or braces to support the sphere in its proper form. . . ." (Pamphlet *cit.*)

The Earth as a Hollow Globe.

The above illustration, which accompanied the pamphlet just cited, shows only one such spherical shell. An addendum to the body of the pamphlet, dated Sept. 23, 1880, recounts statements by the Swedish Professor Norpensjould, who made several northern expeditions under the auspices of the Swedish Government; by an English Captain Wiggins who was accompanied by a Mr. Seebohm; and by an American whaler Captain Tuttle. These all traveled in this warm northern country which they supposed was Siberia, though though they had no knowledge of what the limits of Siberia

were. Mr. Symmes here speaks of it as "Symmzonia." But they all testified to the fact of a country and inhabitants such as Captain Symmes had declared to be in existence. They did this circumstantially, in detail, independently of one another, and each without any knowledge of the others (except that Captain Wiggins and Mr. Seebohm traveled together), and without any of them having ever heard of Captain Symmes' theory. Who can tell what fancies will spring from the brain of a whaling master and his mates as they sit around an ill-smelling stove in a close cabin, and spin yarns that never grow less with the telling? It all sounds like the exploits of Marco Polo or even of some recent explorers.

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A VIEW OF

THE INHABITANTS OF THE MOON,

AS SEEN THROUGH THE TELESCOPE OF SIR JOHN HERSCHEL.

(From an old print)

HOAXES

"Hoax—humorous or mischievous deception" (Oxford Dictionary). Hoaxes, often silly and puerile, have sometimes risen to a dignity to command the attention of large classes of educated people, and have been audacious and clever enough to impose upon them. The imposture frequently takes the character of a posthumous work of some recognized genius in art, science or letters, which has been unearthed in some simple but unexpected manner, and presented by its real author who poses usually as the discoverer. Sometimes it is nothing worse than a practical joke perpetrated with no especial reference to pecuniary profit or to injury to the public; in other cases these results are the direct aim of the perpetrator.

The opportunity to arouse public interest by a faked account of some marvelous achievement is still attractive to journalists. The popular journal *Flying* (New York) for August 1918 contained such a narrative by Alfred E. Poor, of a flight across the Atlantic, said to have been made in an aeroplane July 28 and 29, 1918. The account is circumstantial, with several pictorial illustrations, a chart of the route traversed, Navigator's Log, and numerous details. The flight was from Harbor Grace, N. F., Sunday, July 28, 1918, 7 h. 02 min.; to Dingle Bay, Ireland, Monday, July 29, 1918, 7 h. 12 min.; time of flight, 24 hours, 10 minutes. The story immediately excited great interest, but the facilities for communication nowadays by telegraph, telephone, and wireless are too great for such news to mislead anybody very long, and the editors promptly confessed that the account was a hoax, admirably done, and they hoped the immediate effect would be to stimulate the efforts to make a real attempt at crossing the Atlantic by air flight.

In fact a real attempt was successful less than a year after the date of the pretended one.

The Moon Hoax

In science, one of the most remarkable deceptions was The Moon Hoax, appearing in the New York daily newspaper *The Sun* in 1835. It was a leading feature, filling two or three columns of the paper daily from August 25 to August 31, and was written by one of that newspaper's reporters, Richard Adams Locke. It was developed in accordance with a deliberate plan of its author and Mr. Day, the the proprietor and founder of *The Sun,* as itemized below. It was much easier in those days than now to sustain misinformation from or concerning remote parts of the world.

Item 1: The basis for this deception lay in the Edinburgh *New Philosophical Journal* in Mr. Locke's possession, one number of which, in 1826, contained an article by Dr. Thomas Dick suggesting a scheme of communication between the inhabitants of the earth and those of the moon. Dr. Dick afterward explained that he did not seriously entertain such ideas as feasible, but that he meant to satirize certain German astronomers who were given to vagaries no less absurd.

Item 2: The distinguished English astronomer Sir John F. W. Herschel was noted for having made great advances in the construction of astronomical telescopes, and had established an observatory near Cape Town, Africa, in 1834.

Item 3: On Friday, Aug. 21, 1835, there appeared in *The Sun* a brief paragraph purporting to quote from the *Edinburgh Courant* an announcement of remarkable Celestial Discoveries made by Sir John Herschel at the Cape of Good Hope, and on Tuesday, Aug. 25, appeared a startling three-column account of some of these discoveries under the head lines

GREAT ASTRONOMICAL DISCOVERIES
Lately Made
BY SIR JOHN HERSCHEL, LL.D., F. R. S., &c.
At the Cape of Good Hope.

(*From Supplement to the Edinburgh Journal of Science*)

Note that this account is credited to the Edinburgh *Journal of Science* which had ceased to exist several years earlier, and had been succeeded by the Edinburgh *New Philosophical Journal,* in which Dr. Dick's article had appeared. Furthermore the account was taken, not from the main *Journal of Science,* but from a "Supplement." The readers were treated to half a column of grandiloquence and then to a circumstantial and detailed account of discoveries upon the moon and of the specially constructed apparatus by means of which they were made.

Item 4: The defunct *Journal of Science* explains that it received its information from "Dr. Andrew Grant, the pupil of the elder and for several years past the inseperable (*sic*) coadjutor of the younger Herschel." Apparently Dr. Grant brought back a great deal of material from the Cape. According to the *Journal,* "Engravings of lunar animals and other objects . . . are accurate copies of drawings taken in the observatory," which are variously stated to have been made there by Herbert Home, Esq., by Dr. Grant, and by Dr. Herschel himself. As a fact Mr. Locke improvised sketches and descriptions from which drawings were prepared by a firm of lithographers in New York. At times the solemn, awe-inspired tone of the writing is meant to be very impressive. The accounts of scenery, of land and water formations, of animal life on the planet, gain verisimilitude by the pains which the author takes to explain how it is that these discoveries are just then being made known, and why the information has come in a roundabout way.

Item 5: This plausibility is heightened by including in the narrative other incidents connected with the expedition,

such as the imminent destruction of the observatory. "So fierce was the concentration of the solar rays through the gigantic lens that a clump of trees standing in a line with them was set on fire, and the plaster of the observatory walls all round the orifice was vitrified to blue glass." It would have required no exceptional acquaintance with optics, even at that time, to know that something more than a large lens would have to be invented to make the *focus* of the solar rays extend from the wall of the observatory to and along a line of trees some distance away. That was "depth of focus" with a vengeance. In the period when the moon was not visible "Dr. Herschel directed his inquiries to the primary planets of the system, and first to the planet Saturn." After some elaborate description the narrative says "Having ascertained the mean density of the rings as compared with the density of the planet, Sir John Herschel has been enabled to effect the following beautiful demonstration. (Which we omit as too mathematical for popular Comprehension. *Ed. Sun.*)!" Touches like this give an exquisite finish to the whole story. The public, mystified as they were by it all, found especial amusement in the chagrin of *The Sun's* rivals over its sudden leap into popularity. It is interesting to see the curious ways in which, in commenting on *The Sun's* story, the other papers "hedge" to save their credit if they should doubt what might prove to be true or accept what might turn out to be false. Perhaps the most refreshing was the New York *Evening Post* (edited at that time by William Cullen Bryant and Fitz-Greene Halleck).

"It is quite proper," says *The Post,* "that the *Sun* should be the means of shedding so much light on the *Moon.* That there should be winged people in the Moon does not strike us as more wonderful than the existence of such a race of beings on earth; and that there does or did exist such a race rests on the evidence of that most veracious and circumstantial of chroniclers, Peter Wilkins,

whose celebrated work not only gives an account of the general appearance and habits of a most interesting tribe of flying Indians, but also of those more delicate and engaging traits which the author was enabled to discover by reason of the conjugal relations he entered into with one of the females of the winged tribe."

And there you are! *The Sun* is not the only paper that knows about natural wonders, and the reader may decide for himself how far he will take the *Post's* utterances seriously and how far as banter.

While the story in *The Sun* was still attracting general attention the *Journal of Commerce* decided to reprint it and a reporter, Finn, of the *Journal,* mentioned the fact to Locke of *The Sun.* Locke advised Finn not to print it right away; that he had written it himself—and the secret was out. Locke afterwards protested that he had never intended the story as a hoax but as a satire. If this was a fact he fell into the same pit with Dr. Dick of the *New Philosophical Journal* aforementioned. "It is quite evident," said Locke, "that it is an abortive satire; and I am the best self-hoaxed man in the whole community" (from O'Brien's "*The Story of The Sun*"). The showmen of the day took it up and exhibited it as a diorama, the precursor of the modern "movie," and spectacular stage versions were given.

Years afterward there was some discussion as to whether Locke was indebted to any considerable extent to the French astronomer Jean Nicolas Nicollet for the technical details, but in the main he is accredited with the conception and the execution of the hoax.

At the very time of its appearance Edgar Allan Poe was engaged upon an ambitious moon-story, Hans Pfaal, which was also known as The Balloon Hoax, and one instalment of which had already been published; but the success of Locke's story virtually canceled Poe's and caused its abandonment.

The Cardiff Giant

On the ninth of October 1869, several workmen employed by a Mr. Newell to dig a well on his farm near the village of Cardiff in Onondaga County, New York State, came upon a large stone or boulder which, on further excavating, proved to be a huge figure of a man, lying on his side and distorted in his limbs as if in pain. The figure, which was of gigantic size, was carefully exhumed, astonishing the onlookers as its shape and porportions were revealed, and the news of its discovery was speedily bruited about the neighborhood. Crowds flocked to the place to see it, and tales about it grew marvelously. Mr. Newell placed it under shelter and soon did a thriving business by charging an admission fee upon those who came to view it. Then, as the whole affair was inexplicable, scholars, invited and uninvited, appeared on the scene; and still the wonder grew, and while the wonder lasted it was a money maker. The stone figure, which had already become widely known as "The Cardiff Giant," was taken to New York, Boston, and other places for public exhibition, and discussions and arguments concerning its origin and character rapidly increased in number and acerbity. The illustration is taken from one of the exhibition circulars. The English of this circular is as distorted and as wonderful as the sculptured figure of the giant. It says "Distinguished men in all departments of science have journeyed from far and near to examine, wonder and theorize over it; among them such names as. . . ." (Here follows a list of names of eminent scholars, including among them the name of President White of Cornell University.) While the circular does not say explicitly that these men endorsed the claims made by the exhibitors, or vouched for the antiquity or the genuineness of the object, it cunningly implies their approval. It cites the endorsement of the State Geologist, James Hall, whom

it pronounces "the associate and correspondent and peer of LYELL, and LOGAN, and (*sic*) AGAZZIS!" In reality, Professor Hall's endorsement was very faint, and President White was unequivocal in his disbelief and unsparing in his condemnation of it as a fraud. A summary of the hoax and its exposure was written by him and published in the *Century Magazine* for October 1902, thirty years later.

The figure was as good as meat and drink to biblical enthusiasts who inclined to the theory that it was a petrified man, proving the existence of giants in old times; while paleontologists were concerned to know whether it was old at all. An account of the affair, entitled "The Cardiff Giant and Other Frauds, by G. A. Stockwell, M. D.," was published in the *Popular Science Monthly* for June 1878. From this we learn that the hoax originated with one George Hull of Binghampton, N. Y., in 1868. He prevailed upon his brother-in-law Newell to collaborate with him in his scheme.

From President White's article, cited above, we learn that

"The figure was made at Fort Dodge, in Iowa, of a great block of gypsum there found; that this block was transported by land to the nearest railway station, Boone, about forty-five miles distant; that on the way the wagon conveying it broke down, and that, as no other could be found strong enough to bear the whole weight, a portion of the block was cut off; that, thus diminished, it was

taken to Chicago, where a German stone carver gave it final shape; that, as it had been shortened, he was obliged to draw up the lower limbs, thus giving it a strikingly contracted and agonized appearance; that the under side of the figure was grooved and channeled that it should appear to be wasted by age; that it was then dotted or pitted over with minute pores by means of a leaden mallet faced with steel needles; that it was stained with some preparation which gave it an appearance of great age; that it was then shipped to a place near Binghampton, New York, and finally brought to Cardiff, and there buried," in 1868.

Just about a year later it was exhumed as related above. Although the secret had been well kept it gradually came out. Professor Marsh of Yale exposed the fraud on scientific grounds, and the participants in it, though foxy, were run to earth and eventually gave out the complete story, even Hull himself glorying in the extent to which he had befooled scientific professors, clergymen, and laymen, meanwhile lining his pockets with money.

Other measures that were taken to secure the success of the deception are recounted.

Like the huntsman who aims to hit his quarry if it is a deer and miss if it is a man, the sculptor so wrought this figure as to leave it open to interpretation as a petrified man or as an ancient monumental statue. And precisely this double interpretation was made, dividing the critics into two camps and increasing the interest of the public which, naturally, took sides in this controversy, and thus tacitly accepted the figure itself as unquestionably antique.

Dr. White's account shows admirably the state of mind into which a credulous public falls, when it has an opportunity to indulge craving for the marvelous or the mysterious. This was another instance of that perverse psychology that earlier sustained the Redheffer perpetual motion fraud, and later reveled in the mystery that enveloped the Keely Motor. In each case the masses hugged a delusion. The perpetrators of the hoax were not "square," but they were

quite clear as to what they were about—it was the public that went astray; they departed from the normal further than did the people who engineered the fraud.

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PROPHECIES

Prophets are dreamers more or less secluded if not solitary, reflective, morbid perhaps—visionaries, to a degree mystics, in a sense poets—they relieve their overwrought fancy in figures of speech or in tales of lurid visions. When such an one gets a crotchet in his brain it fills his thoughts by day, and haunts his dreams by night. In time, prophesying becomes a habit with him, or even a business. At all periods and among all peoples there are men and women who profess to find in existing conditions of society—such conditions, for example, as warfare, questionable morality, religious dissensions, conditions of any kind affecting the well-being of Humanity—to find in them the fulfilment of some prophecy either on record or transmitted by tradition. Especially has this been the case with Bible prophecies, and we have not yet reached the end of interpretations of the prophet Daniel.

We shall confine our attention to prophecies concerning science or resting upon a supposedly scientific basis. These include predictions by astrology, weather predictions and some features of divination already discussed under that particular head.

If one claims to have some scientific basis for his statements, or if he claims some occult or at least extraordinary power of divination, he will be heard with more confidence than if he admits that he is guessing. It does not matter how startling his pretension to special knowledge may be, or how completely it contravenes well-established opinion, or how absurd it may appear, the fact that it sometimes turns out correct is evidence there is "something in it," and that is enough for the charlatan to go to work with. It is astonishing how few successes will suffice to counter-

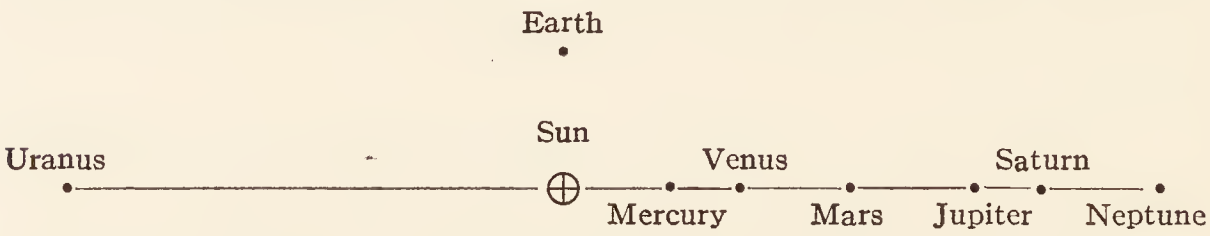
balance innumerable failures. It is almost impossible to miss if the prophet is wisely vague in expressing himself. Dubious or equivocal language is the hall-mark of nearly all fortune telling, clairvoyance, communication with spirits, or other occult performances, and with that qualification, any prediction will be realized *somewhere* completely enough to start or to continue the predicter upon a career as a prophet.

The claimants of special powers in prognosticating become more insistent upon their claims when their scheme has been put upon an orderly, systematic basis. This was preëminently the case with astrology, and later it became so with respect to the weather and anybody can devise a system of astrology or of weather forecasting for himself and safely act upon it. It is not at all necessary that there should be a real scientific connection between celestial positions and terrestrial conditions; just *assume* such connection and then build a system upon the assumption. The fact that some instances have occurred and do occur in agreement with the system will justify it.

Weather prophets have a better substratum on which to erect a structure of predictions, but it will be found that in the most acceptable weather prophecies the plan is more impressive if it contains a mixture of astral and planetary influence upon the state of the weather. There is still a great deal of astrological, especially zodiacal, superstition in weather tokens. Surely the sun, possibly the moon, does influence the state of the weather on the earth, but to the ignorant follower of signs the crescent moon with its horns up, ☽, indicates dry weather for in this position the moon retains the water, while if the horns are turned down, ☾, the water spills out and rainy weather ensues, and that is just as good, to him, as real science.

The practice of astrology and other artificial schemes

of divination are considered under their proper heads (pp. 18, 125); apart from those, actual science has engaged but little in prophesying; generally it confines itself to expecting or at most to hoping. Recently, however, the public was keyed up to a pretty high pitch of interest by a portentous arrangement of the bodies in the solar system.



Professor Porta, an astronomer, ventured to predict for the earth dire calamity if not actual destruction about the seventeenth of December, 1919, owing to the fact that at that date all the planets except the earth would be in a line with the Sun, with Uranus on the opposite side of the Sun from the others, the direction from the sun to the earth being approximately at right angles to the line of the planets. This position was expected to cause great disturbance in the Sun's atmosphere, and this, in turn, was to react upon the Earth in disastrous electric or other storms. The day came and went, and so did the planets, but neither the earth nor the people on it seemed any the worse for the unusual conjunction of the heavenly bodies.

Scholars have usually endeavored to avoid any unnecessary mixing of their scientific theories with their religious convictions, but it seems as if every additional glimpse that science succeeds in getting into hitherto unexplored or unknown domains stimulates the belief that we may yet find a means to communicate with the spirits of the dead, and learn something of the world of spirits (which is not necessarily the same thing as the spiritual world). As a rule, this belief has not been expressed as anything more than a possibility by scientific observers, but physicists have not infrequently passed to spiritualism or at all events to

transcendentalism, and of late eminent men of that class have declared their conviction of its reality.

In respect to prophecy the philosophy of the seventeenth century is about as good as that of the twentieth. Sir Francis Bacon recounts several remarkable instances of discoveries or national crises foreshadowed in dreams, which became prophecies when "interpreted."

We proceed to the consideration of a noted instance of the kind that he says "have been impostures, and by idle and crafty brains, merely contrived and feigned, after the event passed." (Bacon's Essays—*Of Prophecies.*)

Mother Shipton's Prophecy

There is little real knowledge to substantiate the existence of a Mother Shipton; the deeper one dives into the records the more he is inclined to repudiate her outright as a personage, but her name and character are interwoven with so much of legend and tradition that she is a familiar figure like William Tell or other legendary heroes. Her story first appears to have acquired a permanent status in a *History of the Life and Prophecies of Mother Shipton* by Richard Head, published in 1641, and it continued to accumulate mosses for more that two and a half centuries.

The illustration is from a woodcut, the original of which is in one of the rarest editions of the *Prophecies of Mother Shipton,* printed in 1662. It represents her showing York Minster to Cardinal Wolsey on the top of a tower, and the Cardinal vowing vengeance against the witch who had prophesied that he should never get there. On the presentation of the picture to the British Archaeological Association, members called attention to the facts that prophecies in the middle ages were used as political instruments, and were abundant in times of political excitement. They became so troublesome that laws were enacted against them. "They were published under feigned names, generally those

of some celebrated magicians or witches, and Mother Shipton was one of these, and the older prophecies which go under her name appear to have been published about the reign of Henry VIII (1509–1547), when, according to the popular legend, she is said to have lived. This legend appears to have been published in the seventeenth century." (Journal of the British Archaeological Association, MDCCCLXXIII.)

Mother Shipton Admonishing Cardinal Wolsey. (From an old print.)
(*Courtesy of the British Archaeological Association.*)

In the illustration, "Bell, Book and Candle" are all in evidence to exorcise the witch and protect his Eminence the Cardinal from her uncanny powers.

Of course the protraits are caricatures, but it is singular that the dame's headgear should differ so greatly from the conventional peaked hat that distinctly characterized the English witches of that day. The best account of her is given in a fictitious biography, published in London with-

out date, but probably 1872 (certainly later that 1871), made up from earlier publications. According to this she was born July 1488, near Knaresborough, was baptized by the Abbott of Beverly as Ursula Sonthiel; at 24, married Tony Shipton of Skipton; after achieving a wide reputation as a necromancer and prophetess, died at Clifton in 1561.* Most of the prophecies ascribed to Mother Shipton are of a political or personal character, and do not concern us here, but the particular one which in later times has been most commonly thought of in connection with her name is a piece of doggerel predicting various occurrences, many of which are scientific in their nature. This first appeared as one of her prophecies in a version of Head's Life reprinted by Charles Hindley in 1862. The portion of this famous production that is most frequently quoted, beginning "Carriages without horses shall go," and concluding "The world to an end shall come, in eighteen hundred and eighty one," is only a part of the original which is here given in full:

"Over a wild and stormy sea
Shall a noble sail,
Who to find, will not fail
A new and fair countree.
From whence he shall bring,
A herb and a root
That all men shall suit,
And please both the ploughman and the king;
And let them take no more than measure,
Both shall have the even pleasure,
In the belly and the brain.
Carriages without horses shall go,
And accidents fill the world with woe.
Primrose Hill in London shall be
And in its centre a Bishop's See.

* *The Life and Prophecies of Mother Shipton. Mother Shipton's Wonderful Prophecies.* Illustrated London. Also see Dictionary of National Biography.

Around the world thoughts shall fly
In the twinkling of an eye.
Waters shall yet more wonders do
How strange, yet shall be true,
The world upside down shall be,
And gold found at the root of a tree.
Through hills men shall ride
And no horse or ass by their side,
Under water men shall walk,
Shall ride, shall sleep, and talk;
In the air men shall be seen,
In white, in black, and in green.
A great man shall come and go—
Three times shall lovely France
Be led to play a bloody dance;
Before her people shall be free
Three tyrant rulers shall she see,
Three times the people's hope is gone,
Three rulers in succession see,
Each springing from different dynasty.
Then shall the worser fight be done,
England and France shall be as one.
The British Olive next shall twine
In marriage with the German vine.
Men shall walk over rivers and under rivers.
Iron in the water shall float,
As easy as a wooden boat;
Gold shall be found, and found (shown?)*
In a land that's not now known.
Fire and water shall more wonders do,
England shall at last admit a Jew; (foe?)*
The Jew that was held in scorn
Shall of a christian be born and born.
A house of glass shall come to pass
In England, but alas!
War will follow with the work,
In the land of the Pagan and Turk,
And state and state in fierce strife,
Will seek each other's life.
But when the North shall divide the South
An eagle shall build in the lion's mouth.
Taxes for blood and for war,

* Versions differ.

Will come to every door.
All England's sons that plough the land,
Shall be seen, book in hand;
Learning shall so ebb and flow,
The poor shall most learning know.
Waters shall flow where corn shall grow,
Corn shall grow where waters doth flow.
Houses shall appear in the vales below,
And covered by hail and snow;
The world then to an end shall come
In Eighteen Hundred and Eighty One."

Such a prophecy really emanating from a soothsayer in the sixteenth century might well amaze a reader of it in the nineteenth century, but if the reader were skeptical as to the genuineness of the production, it would seem plain to him that the writer of it had coolly set himself to indicate in a quaint and bungling fashion a string of events that he could pick out of a schoolboy's History of England. At least twenty-nine different predictions are made, of some of which the purport is obvious, while others have been thought to refer to events so obscure or of so little consequence that their very appearance in the prophecy is ridiculous. The steam locomotive was supposed to be the realization of one of the predictions (that of the horseless vehicles); next, this was thought to refer to the electric car; with the coming of the bicycle both the steam and the electric carriage gave place to it in the interpretation of the prophecy; but the very general use of the automobile would make it evident that this was the mode of locomotion contemplated if it were not for the last couplet, by which the world was to end before the arrival of the auto. It seems a pity that the date of the final catastrophe was not set a few decades later than eighteen hundred and eighty-one, since much of the prophecy applies better to the world war of 1914–1918 than to earlier occurrences, but when the year "Eighteen Hundred and Eighty One" passed without so

much as a ripple on the surface of the world's affairs, this famous prophecy lost all claim to credence. It was really not necessary to wait so long before abandoning faith in it, for in 1873, the editor of *Notes and Queries*, in Notices to Correspondents, says "Mr. Charles Hindley of Brighton, in a letter to us, has made a clean breast of having fabricated the Prophecy quoted at page 450 of our last volume" (about one third of the above), "with some ten others included in his reprint of a chap-book version, published in 1862."* It was thus officially put to death in 1873, and has of necessity been dead since 1881, but its ghost still walks. It was a double duplicity—a piece of invention foisted by its author upon a prophetess whose own existence was shadowy if not mythical.

Weather Signs and Weather Lore

Perhaps more than any other one thing the weather affects our physical comfort and influences our daily movements. It is a synonym for fickleness, and its uncertainty coupled with its importance has kept mankind on the alert to recognize signs that presage a change.

All peoples, from the most ignorant tribe of savages to the most enlightened nation, have weather signs, many of which are mere superstition, but a considerable proportion are indications in a large and rather indefinite form of what suitable instruments would show more precisely. They are the result of experience, gained from observation, and are sound in the main, although the observers do not know why the "signs" should signify either foul or fair weather.

It is not at all uncommon to hear the prediction that the coming winter will be very cold because the summer just passed was very hot, or *vice versa;* it doesn't matter which order is the approved one—in either one there seems to be no way to end the sequence—it inevitably recalls the per-

* *Notes and Queries,* 4th Series, Vol. XI, 355; Apr. 26, 1873.

plexing question as to the precedence of the chick or the egg. When squirrels garner an unusual supply of nuts or animals acquire an exceptionally warm coat of wool or fur as if, in some mysterious way, they divined the approach of a harsh season and made especial preparation for it, such preparation has been thought to anticipate a severe winter. Similarly there are signs that are thought to indicate the coming of an unusually hot summer. It it for naturalists to say how far such indications may be trusted, and they generally dismiss them as of little importance.

A century ago, in a historical outline of attempts at long range weather forecasting, a writer traced evidences of efforts to answer the question why the weather and consequently the fruitfulness of one year is not like that of another in early Chinese, Chaldean, Arab, Egyptian, Greek, and Latin records.* All these attempts, at least up to the seventeenth century A.D., and in great measure for more than a century later, depended upon astronomical observation and astrological deduction and interpretation. The predictions were most often "seasonal," such as "The prevalent weather at the time the sun enters the sign of Aries will prevail also during the autumn months" (Reymann, 1530). It was the discovery and use of the barometer by Torricelli in 1643 that gave a new turn to atmospheric physics. The development of meteorology that immediately ensued was due to the French Academy.

Signs of an early change in the weather are more common than those relating to entire seasons. Sailors are proverbially weather prophets. It is likely that their skill is due to the fact that their experience is on the ocean, where the surface in all directions is water, and where winds are unobstructed over distances of many miles; and

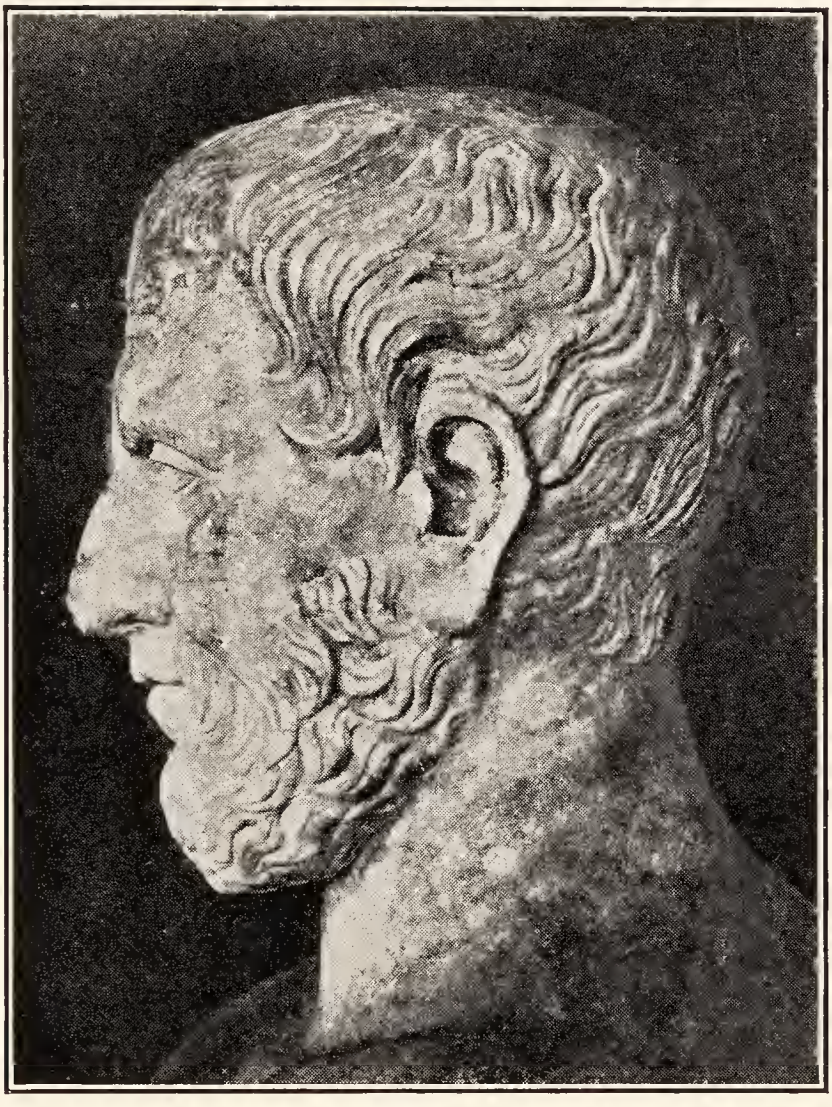
* *Von den bisherigen Versuchen über längere Voraussicht der Witterung. Eine Geschichtliche Skizze,* von Anselm Ellinger, München, 1815.

under these conditions they escape to a great extent the capriciousness that attends the weather inland. Along a seaboard, the weather predicter will distinguish between the influences proceeding from the land side and those from the ocean side, and will shape his predictions accordingly. While the skipper of the Schooner *Hesperus* might see danger in "a gale from the northeast" he might read the sign differently if he were just outside the Golden Gate.

Until weather reports were made the official business of national governments, which is to say within the last half century, weather forecasts were made at the whim of an individual, or were based upon an experience or observations and records of his own, or such as he could gather from limited and not always reliable sources. The predictions were therefore fragmentary and limited, or else largely guesswork. It required the science of meteorology to determine just which of early weather sayings rest upon a scientific foundation, and which are baseless, or are the result of some untrustworthy coincidence; and meteorology could not make much headway, or at least could not be turned to immediate advantage until telegraphic communication became wide and general. Even so, the science is still far from perfected, and the factors of weather are too unsteady to be interpreted for any distance ahead in any simple scheme.

Among the voluminous writings of Aristotle (384 B.C.–322 B.C.) is a treatise on Meteorology which is a philosophical and physical discussion of the subject, scholarly of course and, for the period, unusually good science. It deals, however, only with general principles of climatic conditions and changes. Theophrastus (370 B.C.–c. 285 B.C.), Aristotle's pupil and immediate successor as leader of the peripatetic school of philosophers, also wrote of natural history, including a treatise on the weather. He dealt with his subjects not only in an "up to date" fashion, but he was especially

successful in popularizing them. A few extracts from his list of many weather signs that were common in his day will show the character of the signs then familiarly recognized, and also their similarity to some in common use at the



Theophrastus: From Bust in Villa Albani.

present time. His book was a fountain from which many of his successors drew freely. It is necessary to keep always in mind the distinction between signs that are limited in their application to some definite locality and others which are of a general nature. *Concerning Weather Signs* opens with the statement:

"The signs of rain, wind, storm, and fair weather, we have described so far as was attainable, partly from our own observation, partly from the information of persons of credit."

First of all are signs taken from the sun and moon, especially as to their appearance at times when their risings and settings coincide, or the opposite.

I. *The Signs of Rain*

"Of the signs of rain, most unmistakable is that which occurs at dawn, when the sky has a reddish appearance before sunrise; for this usually indicates rain within three days, if not on that very day. Other signs point the same way; thus a red sky at sunset indicates rain within three days if not before, though less certainly than a red sky at dawn."

A somewhat similar interpretation is applied to the appearance of the full moon. Attention is called to the

"sign of rain if at sunrise or sunset the sun's rays appear massed together";

an appearance which we sometimes designate "The sun drawing water."

"The rising of bubbles in large number on the surface of rivers is a sign of abundant rain."

Rain or wind may be read with considerable precision in the size and form of the snuff of the lamp wick. Innumerable indications are seen in the behavior of birds, animals, and insects: their actions and their noises. Especially is it a sign of rain *when frogs become vocal.* A sign that has twenty-three centuries back of it may well claim the respect due to age.

"It is a sign of rain or storm . . . if any pot filled with water causes sparks to fly when it is put on the fire. It is also a sign of rain when a number of millipedes are seen crawling up a wall."

Then a number of inferences are drawn from winds, clouds, etc., in combination with the appearance of the stars or constellations.

II. *The Signs of Wind*

"Black spots on the sun or moon indicate rain, red spots wind."

The horns of *the crescent moon,* together or singly, are very significant by their shape and position.

"It is a sign of rain when gulls and ducks plunge under water, a sign of wind when they flap their wings. A dog rolling on the ground is a sign of violent wind. The moaning of the sea is a sign of wind. A mock sun, in whatever quarter it appears, indicates rain or wind. If the feet swell there will be a change to a south wind. This also sometimes indicates a hurricane. So too does it, if a man has a shooting pain in the right foot. The behavior of the hedge hog is also significant; this animal makes two holes wherever he lives, —one towards the north, the other towards the south; now whichever hole he blocks up, it indicates wind from that quarter, and if he closes both, it indicates violent wind."

Then come indications from looming or distorted appearance of objects on account of atmospheric peculiarities. In like manner he recounts

III. *"Signs of Storm, and*
IV. *The Signs of Fair Weather"*

"It is a sign which fulfils itself in fair weather when an ox lies on his left side, and also when a dog does the same; if they lie on the right side it indicates storm."

It is impossible to know how far Theophrastus meant his weather signs to be accepted. It is a question whether he was not doing what others have done since his time, viz., merely exhibiting the weather lore current at the time he wrote, and enjoying for himself the inseparable mixture of truth and error in it. He was a philosopher, and possibly was not wholly free from superstition, but he could not fail to see that superstition had a large part in the weather signs. His work is of value to us as being one of the very earliest epitomes of weather signs and beliefs in systematic form. Weather indications were considered a proper feature of treatises on Natural History, and early

writers on that subject usually included sayings and proverbs similar to those just quoted.

Virgil (70 B.C.–19 B.C.) in his *Georgics* enumerates many of the signs popular at that time. The weather is so essentially commonplace, and so prosaic—so naturally the resource of a vacant intellect—that it might be thought the last topic in the world to inspire a poet, and yet the *Georgics,* altogether an agricultural effusion, has been called the most finished poem in the Latin language, and by Addison the most finished of all poems.

It is in the first book of the *Georgics* that the passages concerning the weather occur, and Dryden in his translations says " The poetry of this book is more sublime than any part of Virgil, if I have any taste."

In view of such eulogies, it may not be amiss here to quote the most salient of these weather passages. The following are the simplest and most direct. If they have no greater scientific value they make better reading than the bald statements of Theophrastus or Pliny.

" And that by certain signs we may presage
Of heats and rains, and wind's impetuous rage,
The Sovereign of the heavens has set on high
The moon to mark the changes of the sky;
When southern blasts should cease, and when the swain
Should near their folds his feeding flocks restrain.
For, ere the rising winds begin to roar,
The working seas advance to wash the shore;
Soft whispers run along the leafy woods,
And mountains whistle to the murmuring floods.
Even then the doubtful billows scarce abstain
From the tossed vessel on the troubled main;
When crying cormorants forsake the sea,
And, stretching to the covert, wing their way;
When sportful coots run skimming o'er the strand;
When watchful herons leave their watery strand,
And, mounting upward with erected flight,
Gain on the skies and soar above the sight.

And oft, before tempestuous winds arise,
The seeming stars fall headlong from the skies,
And, shooting through the darkness, gild the night
With sweeping glories, and long trails of light;
And chaff with eddy-winds is whirled around,
And dancing leaves are lifted from the ground;
And floating feathers on the waters play.

.....

Wet weather seldom hurts the most unwise;
So plain the signs, such prophets are the skies.
The wary crane foresees it first, and sails
Above the storm and leaves the lowly vales;
The cow looks up, and from afar can find
The change of heaven, and snuffs it in the wind;
The swallow skims the river's watery face;
The frogs renew the croaks of their loquacious race;
The careful ant her secret cell forsakes,
And drags her eggs along the narrow tracks;
At either horn the rainbow drinks the flood;
Huge flocks of rising rooks forsake their food,
And, crying, seek the shelter of the wood.
Besides, the several sorts of watery fowls,
That swim the seas or haunt the standing pools,
The swans that sail along the silver flood,
And dive with stretching necks to search their food,
Then lave their backs with sprinkling dews in vain,
And stem the stream to meet the promised rain.
The crow with clamorous cries the shower demands,
And single stalks along the desert sands.
The nightly virgin, while her wheel she plies,
Foresees the storm impending in the skies,
When sparkling lamps their sputtering light advance,
And in the sockets oily bubbles dance.

.....

Above the rest, the sun, who never lies,
Foretells the change of weather in the skies;
For, if he rise unwilling to his race,
Clouds on his brow and spots upon his face,
Or if through mists he shoots his sullen beams,
Frugal of light, in loose and straggling streams;
Suspect a drizzling day, with southern rain," *

* Dryden's translation of *The Georgies* of Virgil; Book I.

This is contrary to the usual expectation of a fair day to follow a gray sunrise; and the equally common prediction of a fine day to follow a red sunset is contradicted in what follows, or at least limited to a "purple" sunset.

"But, more than all, the setting sun survey,
When down the steep of heaven he drives the day;
For oft we find him finishing his race,
With various colors erring on his face.
If fiery red his glowing globe descends,
High winds and furious tempests he portends;
But, if his cheeks are swoln with livid blue,
He bodes wet weather by his watery hue;
If dusky spots are varied on his brow,
And, streaked with red, a troubled color show;
That sullen mixture shall at once declare
Winds, rain, and storms, and elemental war.
But, if with purple rays he brings the light,
And a pure heaven resigns to quiet night,
No rising winds, or falling storms, are nigh." †

A much more parsimonious use of omens may make a poem effective. The use of just one "sign" enabled Charles Kingsley to give an exquisite touch of premonition and pathos to the close of each verse, in his poem of *The Three Fishermen:*

"Three fishers went sailing out into the west—
Out into the west as the sun went down;
Each thought of the woman who loved him the best,
And the children stood watching them out of the town;
For men must work, and women must weep;
And there's little to earn, and many to keep,
Though the harbor bar be moaning."

Virgil is supposed to have taken many of his weather signs from the Greek poet Aratus of Soli, whose *Phaenomena* was published about 70 B.C. Much of the above quotation is almost a literal transcript from that work; but further comparison shows that Aratus, to a great extent, was re-

† Ibid.

peating Theophrastus, from whom several examples are cited above (pp. 222, 223).

These superstitions and fancies concerning the weather, common among the ancients, persisted through the Middle Ages.

A compendium of rules for judging the weather, first published in 1744, was ascribed to "The Shepherd of Banbury," and had evidently become proverbial in England before their publication. This little book was compiled by John Claridge, and has an Introduction supposed to have been written by John Campbell, LL.D. The "Rules" purport to be based upon forty years' experience, and are a very respectable attempt at an analysis of the signs in their relation to atmospheric conditions, such as mists, clouds, winds, and rain. Most of the rules are for short time predictions; but as to seasonal or monthly portents, while reminding the reader that a rule good for one locality may not be applicable to another, the writer says

"It may not be amiss to remark that it is highly probable, or rather absolutely certain, that the Weather in one Season of the Year determines the Weather in another. For Instance, if there be a rainy Winter, then the Autumn will be dry, if a dry Spring then a rainy Winter."

This gives a range of six to nine months to the seasonal forecast. He continues

"Our Forefathers had abundance of odd Sayings upon this Subject, and some Proverbs for every Month in the Year." *

As an example of the latter he gives this part of an old jingle:

"*Janiveer* freeze the Pot by the Fire
If the Grass grow in *Janiveer*
It grows the worse for't all the Year.
The *Welchman* had rather see his Dam on the Bier
Than to see a fair *Februeer*.

* *The Shepherd of Banbury's Rules To Judge of the Changes of the Weather.* London, 1744.

March Wind and *May* Sun
Makes Clothes white and Maids Dun.
When *April* blows his Horn
It's good both for Hay and Corn.
An April Flood
Carrys away the Frog and her Brood.
A cold *May* and a windy
Makes a full Barn and a Findy.
A May Flood never did good.
A swarm of Bees in May
Is worth a load of Hay
But a Swarm in *July*
Is not worth a Fly, etc."

In some portions of America the proverb concerning the bees includes the couplet

"A swarm of Bees in *June*
Is worth a silver spoon."

The first of the Shepherd's Rules was "If the Sun rise red and fiery—wind and Rain"; and the second, "If cloudy, and the clouds soon decrease—Certain fair weather." The author moralizes upon the weather changes and admonishes the reader that it is a good thing the weather does change! And assures him that there is nothing whatever about it that is *accidental,* but that it is entirely directed by Providence for the good of mankind in general.

This interesting volume was followed in 1773 by *An Essay on the Weather, with Remarks on the Shepherd of Banbury's Rules,* by John Mills, Esq. This author says "Who the Shepherd of Banbury was, we know not; nor indeed have we any proof that the rules called his were penned by a real shepherd." In addition to his remarks on The Shepherd's "Rules" he makes critical judgment of the weather on his own part, and quotes freely from Virgil as we have done above. He further enumerates signs by earthworms, moles, fleas, spiders, flies, bees, gnats, birds, etc., and closes the chapter (II)

"in *men;* frequently aches, wounds, and corns are more troublesome either towards *rain* or towards *frost.*"

An experience that does not seem to be limited to any one place or period. After some further analysis he says

"Hence we may account for an observation adopted into all languages, *The evening* red, *and the morning* gray, *is a sign of* a fair *day.*"

It is related of Dr. Edward Jenner, the discoverer of vaccination, that by way of declining an invitation to go upon an excursion with a friend, he wrote the following, which has been thought the most complete epitome of popular signs of rain extant:

"The hollow winds begin to blow,
The clouds look black, the glass is low;
The soot falls down, the spaniels sleep,
And spiders from their cobwebs peep.
Last night the sun went pale to bed,
The moon in halos hid her head;
The boding shepherd heaves a sigh,
For, see, a rainbow spans the sky,
The walls are damp, the ditches smell,
Closed is the pink-eyed pimpernel.
Hark, how the chairs and tables crack,
Old Betty's joints are on the rack;
Loud quack the ducks, the peacocks cry,
The distant hills are looking nigh.
How restless are the snorting swine,
The busy flies disturb the kine;
Low o'er the grass the swallow wings;
The cricket, too, how sharp he sings;
Puss, on the hearth, with velvet paws,
Sits, wiping o'er her whiskered jaws.
Through the clear stream the fishes rise,
And nimbly catch th'incautious flies;
The glow worms, numerous and bright,
Illum'd the dewy dell last night.
At dusk the squalid toad was seen,
Hopping and crawling o'er the green;
The whirling wind the dust obeys,
And in the rapid eddy plays;
The frog has changed his yellow vest,
And in a russet coat is dressed.

Though June, the air is cold and still;
The blackbird's mellow voice is shrill.
My dog, so alter'd is his taste,
Quits mutton bones, on grass to feast;
And see yon rooks, how odd their flight,
They imitate the gliding kite,
And seem precipitate to fall—
As if they felt the piercing ball.
'Twill surely rain, I see with sorrow,
Our jaunt must be put off tomorrow."

The Weather Bureau is our best barrier against the flood of weather superstitions. Among its many valuable publications, an excellent compendium is Bulletin No. 33, entitled *Weather Folk-Lore and Local Weather Signs,* by Professor Edward B. Garriott, issued in 1903. This recounts at considerable length the notions and proverbs that have acquired popularity in the folk lore of different nations, some wise, some weather-wise, some otherwise, distributing them under appropriate heads such as Winds, Clouds, Barometer, Temperature, Humidity, Animals, Birds, Fish, Insects, Plants, The Sun, The Moon, The Stars; all these for short time predictions. Then a dozen pages are given to the consideration of long range forecasts from astronomical positions, and the conduct of animals, birds, etc. It includes many of the examples we have already given, and explains the scientific basis of many of the popular sayings. We select a few familiar ones:

Enough blue sky in the northwest to make a Scotchman a jacket is a sign of approaching clear weather. (Sometimes "A patch of blue sky big enough to make a Dutchman a pair of breeches.")

Everything is lovely and the goose honks high; Wild geese and most other birds fly high in pleasant weather and low when the barometer pressure is low.

Smoke falls to the ground preceding rain.

Human hair (red) curls and kinks at the approach of a storm, and restraightens after the storm.

Lamp wicks crackle, candles burn dim, soot falls down, smoke descends, walls and pavements are damp, and disagreeable odors rise from ditches and gutters before rain.

Hogs crying and running unquietly up and down with hay or litter in their mouths foreshadow a storm to be near at hand.

If fowls roll in the dust and sand, rain is at hand.

When the peacock loudly bawls,
Soon we'll have both rain and squalls.

When fish bite readily and swim near the surface, rain may be expected.

Ants are very busy, gnats bite, crickets are lively, spiders come out of their nests, and flies gather in houses just before rain.

The leaves of the quaking asp, cottonwood, sugar maple, lime, sycamore, plane, and poplar trees show a great deal more of their under surface before rain, when trembling in the wind.

The Sun drawing water indicates rain.

A solar halo indicates bad weather.

A lunar halo indicates rain, and the larger the halo the sooner the rain may be expected. (With a corona, the contary is true as to the size of the ring.)

And the signs are not always dismal, as witness the chipper

Rain before seven, clear before eleven.

Among long range predictions, there are several of the common ones in which the coming of a severe winter is to be inferred from the gathering of extra supplies of food by animals, or from precautions in building and protecting their houses. Also the weather on a particular day or month tells what to expect at a future day or season.

As the days lengthen
So the cold strengthens;
As the days begin to shorten,
The heat begins to scorch them.

On Candlemas Day (Feb. 2) the bear, badger or wood-chuck (ground hog) comes out to see his shadow at noon; if he does not see it he remains out; but if he does see it he goes back to his hole for six weeks, and cold weather continues for six weeks longer.

If March comes in like a lamb it will go out like a lion.

Rain on St. Swithin's Day (July 15) means rain every day for forty days thereafter.

Always expect a thaw in January.

Besides the explanations given by Professor Garriott, a few of these are entitled to some further comment.

A halo is a pale circle around the sun or moon, tinged with red on the inner side, and having a radius of either 22° or 46°; i.e., the distance from the ring to the luminary is about one quarter or one half as great as the distance from the zenith to the horizon. The halo is caused by the refraction of light through minute ice crystals in the air, and is supposed to portend rain.

A corona is also a colored ring about the sun or moon, red on the outside, and varying in position from close to the luminary to a distance of fifteen or twenty degrees. This also indicates coming rain or snow, and the smaller the ring the sooner the bad weather may be expected to arrive. When it is the moon that is thus encircled, and the corona appears at night, this feature of the portent is sometimes expressed by saying that the number of days to elapse before the rain is told by the number of stars to be seen within the ring. Now the corona will not be formed until there are minute globules of water in the air, or the exceedingly fine water-particles in vapor have begun to coalesce. The conditions have set in for rain, and the larger the droplets grow the smaller the corona becomes, and the nearer the precipitation of moisture. Of course the more opaque the atmosphere or the smaller the ring the fewer stars can be seen within the circle but, other than this, there is no ground for fixing the number of days before the rain by the number of stars discernible within the ring. This resembles the case of many a prophecy:—there is not much likelihood of error in it, for the stars are never more than three or four in number (usually fewer), and the change of weather is never more than three or four days off (usually fewer).

If smoke rises in a vertical column to a considerable height before it disappears by general diffusion, that means that the atmosphere is heavy, with no threatening change on account of wind—just what a steady high barometer column

would mean, and the smoke column is a barometer. It indicates fair weather. If the smoke sinks to the earth the atmospheric pressure is low, and again the smoke is a barometer; bad weather is probably impending.

The curling of the hair and the precipitation of water on metal or stone surfaces are due to an increase of moisture in the air, and each is an example of a special type of hygrometer. These signs, in fact, only show the stage that has been reached in a change that is already in progress.

The Universal Weather Proverb

Of all weather sayings, one that has been common to all peoples and at all times is that with respect to the color of the sky in the evening and the morning. Occurring in many languages it is variously phrased to suit various fancies, protean in form yet essentially the same in idea. A few examples of it will show, however, that it is not specific enough to fit all places alike. We have already seen the form in which it is given by Theophrastus, by Virgil (whose statement is like that of Aratus), and by the Shepherd of Banbury, and we may add a few more, all variants of the same theme:

When it is evening, ye say, It will be fair weather: for the heaven is red. And in the morning, It will be foul weather today: for the heaven is red and lowering. *Matthew, XVI, 2, 3* (Revised Version).

Evening red and morning gray
Will set the traveler on his way,
But evening gray and morning red
Will bring down rain upon his head.

Red sky at night, sailors' delight,
Red sky in the morning, sailors take warning.

An evening gray and a morning red
Will send the shepherd wet to bed.

Evening red and morning gray,
Two sure signs of one fine day.

Red skies in the evening precede fine tomorrows.

". . . a red morn, that ever yet betoken'd
Wreck to the seaman, tempest to the field,
Sorrow to shepherds, woe unto the birds,
Gusts and foul flaws to herdsmen and to herds."

(Shakspeare, *Venus and Adonis.*)

Universal as this prophecy is, to make a fetish of it is to invite the iconoclast. A German yachtsman concerned with weather prognostics sees in successful weather prophesying something more than a mere conformity to rules; there is generally an indefinite *feeling* of what the weather is going to be or do: a "weather instinct," which some persons possess and others do not, and he has discovered the weakness as well as the strength of this generally accepted weather formula. He finds that for a landsman official weather forecasts are not to be depended upon. He gives two well-defined formulas as best expressing what he could gather from persons possessing "weather instinct."

"(1) Change in the weather is always preceded (for general and wide-reaching change six to twelve hours, for local changes two to six hours) by changes in the tone or harmony of the atmosphere (*Luftstimmung*) at the horizon or even in higher strata. So long as those signs do not appear a continuance of the prevailing weather is assured.

"(2) Bad weather, especially a tendency to falling weather is always preceded and usually followed by clouds in double layers (and apparently in every bad weather doubled strata are present). Single layers, on the other hand, and a clear sky indicate dry weather." *

Of the saying "Morning red brings wind and mud" (*Morgen rot bringt Wind und Kot*), he thinks this cannot mean the same red as that of the evening twilight, but red *illuminated clouds* shortly before sunrise; this does not necessarily bring rain. When, however, the morning red belongs to a cloud bank of several layers, rain will surely follow. Unless due regard is paid to the arrangement of

* *Wetter-Instinkt*, F. Mylius, Magdeburg, 1906.

clouds, whether in a single layer or in double layers, neither the evening red nor the morning red is definitely significant. The red twilight may appear with either formation of clouds—with the single layer, or with no especial cloud layer, fair weather will follow; but if, as may occur, there is present a double-layer cloud bank, then, in spite of the most splendid evening red, bad weather will ensue.

That a gray morning sky will bring fine weather he thinks also needs qualifying. It can be depended upon only when a cloudless morning sky looks a bright gray instead of blue in consequence of a light mist. This is followed by a fine day, for the rising sun dispels the slight mist, and there is no threatening cloudbank present. "Not always," he says, "is evening red a messenger of fine weather, nor does every morning red bring wind and mud." (*"Nicht immer ist Abendrot 'Schoenwetterbot,' noch bringt jedes Morgenrot 'Wind und Kot.'"*)

National Weather Service and Long Range Forecasts

Official weather service has been undertaken by practically all the principal national governments and by many of the lesser ones, and the United States Weather Bureau has been indefatigable in its efforts to determine real scientific data, as also to sift the true from the false in earlier ideas and practices, and to combat superstition, error, and sham in connection with weather forecasts. The warning storm signals displayed under its direction are most valuable to shipping, and in spite of the criticism to which it is at times subjected, a discontinuance of its work would be a national disaster. Gilbert H. Grosvenor, Editor of the *National Geographic Magazine,* estimated in 1905 that the saving to the people of the United States was about $30,000,000 every year because of their weather service.*

* "Our Heralds of Storm and Flood," *The Century Magazine* for May, 1905.

Systems for forecasting the weather, more or less well founded or ill founded, are launched from time to time, and usually acquire a vogue, at least for a while. Such was the table of Sir John Herschel, connecting the state of the weather with the time of day when the moon entered upon either phase—new moon, first quarter, full moon, or last quarter. (See p. 46.)

A more recent, elaborate system was promulgated by a Russian engineer, M. Demtchinski, in 1900. This was based upon the supposed influence of the moon, and made it possible to predict the weather " for any period in advance." Like all other systems of prophesying, it is verified often enough to make it a bone of never-ending contention between its advocates and its opponents.

Besides the Bulletin No. 33 of the U. S. Weather Bureau, of which we have spoken at length, Bulletin No. 35, entitled *Long Range Weather Forecasts,* by Prof. E. B. Garriott, 1904, and No. 42, *Weather Forecasts,* by George S. Bliss, 1917, together with the paper on *The Physical Basis of Long Range Weather Forecasts,* by Professor Cleveland Abbe, take account of the investigations and publications of the best workers in the Bureau and their best authorities, and state in concise, interesting, and valuable form what the Bureau has been able to learn and to do along this line. Professor Abbe very forcibly points out the importance of correlating the telegraphic reports from all over the country, work which the Bureau has systematized to perfection, since *we cannot expect to foresee weather unless we can foresee the factors of weather.* Bulletin 35, on long range weather forecasts, is a scathing arraignment of attempts at forecasting for a year at a time, notably such attempts as we have spoken of in connection with Hicks' Almanac. The authors of the two principal portions of this bulletin are Professors Garriott and Woodward, the latter of whom shows the absurdity of predicting by the planets, especially Vulcan. The

whole paper is most searching and valuable, but we may give only the conclusions:

"1. That systems of long range weather forecasting that depend upon planetary meteorology; moon phases, cycles, positions, or movements; stellar influences, or star divinations; indications afforded by observations of animals, birds, and plants; and estimates based upon days, months, seasons, and years have no legitimate bases.

"2. That meteorologists . . . have found that while the moon, and perhaps the planets, exert some influence upon atmospheric tides, the influence is too slight and obscure to justify a consideration of lunar and planetary effects in the actual work of weather forecasting.

"3. That the stars have no appreciable effect upon the weather.

"4. That animals, birds, and plants show by their condition the character of past weather, and by their actions the influence of present weather and the character of weather changes that may occur within a few hours.

"5. That the weather of days, months, seasons, and years affords no indications of future weather further than showing present abnormal conditions that the future may adjust.

"6. That six and seven day weather periods are too ill defined and irregular to be applicable to the actual work of forecasting."

"7, 8, and 9 emphasize the importance of extending observations over larger areas; a study of solar influence on abnormal distribution of atmospheric pressure; the sympathy and not antagonism of meteorologists towards honest efforts to solve the problem of long range forcasting; that they appreciate its importance and "are inclined to believe that the twentieth century will mark the beginning of another period in meteorological science."

In the more recent Bulletin, No. 42, (1917), the author Mr. George S. Bliss repeats some of these conclusions and adds others. Particularly for local forecasting he says:

"Weather proverbs will not be found to be generally applicable, and only those which, when analyzed, are found to be based upon scientific fact and principles will be worth considering.

"Observations pertaining to the condition of the atmosphere, the appearance of the sky, the character and movements of the clouds, and the direction and force of the winds are, generally speaking, all that are worth testing out, for one's particular locality.

"Proverbs regarding the actions of birds and animals are usually

of little value. *Marked changes in the atmospheric conditions* are responsible for their peculiar antics, and these same changes are generally preceded by reliable indications if one learns to observe and interpret them.

"Sayings which pertain to the moon and planets are wholly foreign to the subject, and those which apply to forecasts for coming seasons are entirely without foundation. Peculiar growths and developments in vegetation are the results of weather conditions that have passed and have no connection with those to come. The character of the muskrat's house or the beaver's dam is the direct result of the stage of the water at the time the structures were made."

Recent authorities suggest a connection between the planets and the occurrence of sun-spots, and these affect solar radiation and the condition of the atmosphere, and indirectly the weather. (See Climatic Changes, Their Nature and Causes, by Ellsworth Huntington and S. S. Visher.)

Probably the officials themselves would not claim that the last word has been said on this subject. Weather conditions in some countries are less complex than in the United States, and where the seasons of the year are virtually reduced to two, and the character of the weather for each season is formed principally by long continuing winds, it may be to some extent foreknown. This is the case with the climate of India and there seems to be some hope of achieving long range forecasts in that country.*

It is easy to understand that so long as the impression prevailed that year in and year out the amount of heat received from the sun by the earth was about the same and that the supply of heat from the sun was practically steady, an excess or defect in one season was likely to be compensated in another; but since physicists have shown the variability of the so-called "solar constant," it becomes necessary to learn whether terrestrial weather undergoes changes corresponding to those of solar radiation. And now comes a startling addition to the lore of this subject.

* See *Scribner's Magazine,* March, 1897, p. 394.

Peculiarly pertinent, just here, is a recent paper from the Smithsonian Institution, by H. Helm Clayton, with an introductory note by C. G. Abbot. This paper is a remarkable contribution, especially in view of the statements on p. 55, and by Profs. Garriott and Woodward, p. 237, and Prof. McAdie, p. 240 following. We may quote only the first portion of Dr. Abbot's "Introductory Note," which will indicate the significance of Mr. Clayton's work.

"Nearly forty years ago the late Secretary Langley, at that time Director of the Allegheny Observatory, made the following remarkable statement in his report of the Mt. Whitney Expedition.

"'If the observation of the amount of heat the sun sends the earth is among the most important and difficult in astronomical physics it may also be termed the fundamental problem of meteorology, nearly all whose phenomena would become predictable if we knew both the original quantity and kind of this heat; how it affects the constituents of the atmosphere on its passage earthward; how much of it reaches the soil; how through the aid of the atmosphere it maintains the surface temperature of this planet, and how in diminished quantity and altered kind it is finally returned to outer space.'

"Let us set over against this pronouncement of Langley the final conclusion of Mr. Clayton in the paper which follows:

"'The results of these researches have led me to believe: 1. That if there were no variation in solar radiation the atmospheric motions would establish a stable system with exchanges of air between equator and pole and between ocean and land, in which the only variations would be daily and annual changes set in operation by the relative motions of the earth and sun. 2. The existing abnormal changes, which we call weather, have their origins chiefly, if not entirely, in the variations of solar radiation.'"

Dr. Abbot thinks Mr. Clayton's conclusion "is of a very revolutionary character and deserves the most careful attention of meteorologists." The rational procedure and the sane conclusions of the Weather Bureau remove from the proverbs of our ancestors much of the fantastic and superstitious, and probably prevent some mistakes, but they also take a good deal of the spice out of life, for absurd as many

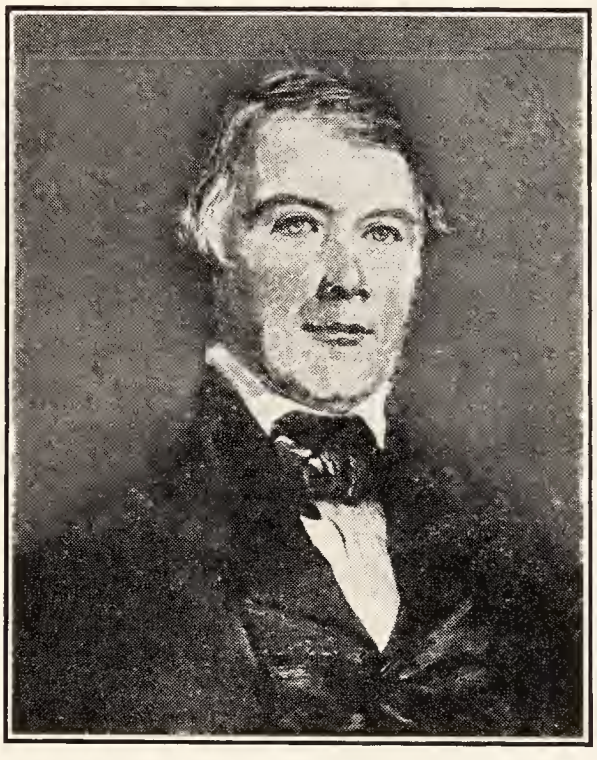
of these old saws were, they were catchy, and contributed to popular enjoyment by their sharpness of point and quaintness of expression.

Weather Control; Rain-Making and Rain-Makers

It is not in human nature to suffer from a prolonged or repeated evil without seeking for a remedy. Severe weather of any kind—heat, cold, rain or drought—if long continued causes distress and the only way to escape the ill effects of such extremes is to control the weather, either to mitigate it when it is becoming too severe or to take proper measures in advance to secure the kind of weather that is wanted. Savages and unenlightened peoples have resorted to all sorts of charms and incantations; to medicine-men, rainmakers, rain-gods, etc. Their ceremonies are often curious and ingenious; some are grossly superstitious and others are mere chicanery, but usually the method of the rainmaker among primitive folk is based on homeopathy or imitative magic—for instance, he will attempt to produce a noise like thunder with the idea that this will result in the bursting forth of the genuine article and its attendant rain; also, when a cat washes her face it is a sign that rain is coming, so, to bring about a rain, he will subject puss to a bath in spite of her repugnance to it. These practices have been common also with pagan nations of the highest civilization. Jupiter Pluvius was one of the most potent of the Roman Deities, and of course when the gods controlling the elements are angry they must be propitiated by suitable ceremonies. But the actual control—the production, prevention, or moderation of any special kind of weather over large districts—has not been accomplished though it has been undertaken with regard to the production of rain, and the prevention of frost, and it has been thought that "rain-control is a scientific possibility. Successful rain engineers will come, in time, from the ranks of those who study and clearly

understand the physical process of cloud formation." * The modern rainmaker therefore can be nothing if he is not scientific. He must have a scientific ground for his process however fallacious it may be.

If any one can be called the Father of the United States Weather Service, it is James Pollard Espy (1785–1860).



Portrait of James Pollard Espy ("Old Storm King")
(*Courtesy of D. Appleton and Co.*)

From his meteorological studies he evolved a theory of the manner in which clouds are formed in high regions of the atmosphere and produce rain. This was to the effect, essentially, that heated air at any locality rises into rarer regions and expands; this expansion is accompanied by fall of temperature which condenses the vapor in the immediately contiguous air as well as within the ascending column; this condensation liberates sufficient heat to stimulate the further rise of the central column of air, with continuous expan-

* *Popular Science Monthly* for September, 1895, "Natural Rain-Makers," by Alexander McAdie.

sion, cooling and condensation of vapor into clouds, until they are eventually precipitated as rain.

He thought that this natural process could be accomplished artificially by maintaining large fires over extensive areas, and sought governmental aid to undertake experiments for that purpose. He cited the practice of American Indians in burning the prairies to produce rain, and his agitation of the subject attracted so much attention that numerous instances were reported which seemed to confirm his theories, but his petitions to the legislature of Pennsylvania and to Congress were humorously refused. He acquired high repute as a meteorologist in Europe as well as at home, and in 1843 he was placed in charge of the meteorological work of the U. S. Signal Service.

Although Espy's theories are now known to be not wholly sound, their promulgation was a great incentive to further work along their line. The many instances of rain occurring either during or immediately after a severe battle or heavy cannonading had been often commented upon, and in 1871 Mr. Edward Powers published a book on "War and the Weather" containing a large collection of data to show that heavy cannonading was followed even in very dry regions by copious rainfall. He developed a theory that although concussion did not cause the formation of clouds in the surface atmosphere, which was lacking in moisture, in some way it did cause precipitation from the higher strata of air which carried moisture. His contention all turned upon the question whether, in the United States, in times of drouth at the surface of the earth, the upper air has a considerable supply of moisture derived not from surface evaporation, but brought from the Pacific Ocean; that "it is not the moisture of the surface air east of the mountains that causes the rain; it is the rain that causes the moisture." * The idea that at a great height there is a generally prevalent

* *War and the Weather,* Revised Ed., p. 156, 1890.

flow of air eastward and above that a stratum flowing westward is still entertained, and aviators are seeking to determine whether it is correct.

As might have been expected, Mr. Powers' theory too was poohpoohed, but his arguments and illustrations were too cogent to be ignored, and the prospect of large financial benefit that might be obtained from a successful application of these ideas in the production of rain was alluring enough to induce capitalists to finance an attempt on a large scale. The national government went so far in its sanction of the enterprise as to authorize an expedition for the purpose of conducting experiments under the direction of General R. G. Dyrenforth. The Midland Ranch, in the northwestern part of Texas, was selected for the place to conduct the experiments, which were frequent and varied, during the period from the ninth to the twenty-fifth of August, 1891. Both the place and the season were thought to be above rather than below average dryness. The affair attracted much attention, and reports of the experiments were read eagerly throughout the whole country. Various forms of bombs and balloons were used to produce explosions and concussions at different altitudes. General Dyrenforth's report to Congress (Senate: *Ex Doc. No.* 45, February 25, 1892) was to the effect that the experiments were not extensive enough or sufficiently long continued to make safe deductions; and Mr. George E. Curtis, who was meteorologist for the expedition, concluded that "these experiments have not afforded any scientific standing to the theory that rain-storms can be produced by concussions." At the same time, the leaders and participants in this expedition did not think the theory was disproved, and its advocates regarded the tests as insufficient. Much discussion followed. Professor Alexander McFarlane, of the University of Texas, in a letter to the *San Antonio Daily Express,* of December 4, 1891, said "The

trial of Friday, August 25, was a crucial test, and resulted not only in demonstrating what every person who has any sound knowledge of physics knows that it is impossible to produce rain by making a great noise, but also that even the explosion of a twelve-foot balloon inside a black rain cloud does not bring down a shower." This "crucial test," however, was followed next day by a precipitation that was characterized by different persons as anything from a mere sprinkle to a heavy rainfall, two or three miles to the northwest of the place where the experiment was made, but in a direction in which the wind would have carried the clouds. It was not certain that the rain was due to the explosions, and it was unfortunate that the experiments resulted in this negative fashion and were inconclusive. One consequence of these efforts, especially to be noted, is related by Mr. Curtis. He calls attention to the rash conclusions that were drawn from the telegraphic and incomplete reports of the effect even of preliminary experiments and trying out of the apparatus, and adds "charlatans and sharpers have not been slow to seize the opportunity thus afforded. Artificial rain companies have sprung up and are now (1892) busily engaged in defrauding the farmers of the semi-arid States by contracting to produce rain, and by selling rights to use their various methods." *

Thirty years have elapsed since the Dyrenforth experiments—what has become of the weather-mongers' pseudo-scientific pretensions and practices? As lately as February 1, 1921, the public press reported from *Medicine Hat, Alberta,* the announcement by the United Agricultural Association that "Rainmaker" Hatfield *had been engaged to increase precipitation* during the dry season at the rate (*sic*) of $4,000 an inch. The "Rainmaker" says he can

* *The Engineering Magazine,* July, 1892. See also various articles concerning this expedition in the *American Meteorological Journal* for 1892–1893.

produce rainfall by chemical and other scientific methods, and is to operate over a section of about one hundred miles radius. That last is a very clever stipulation. It greatly increases his chance of success and makes it much safer for him to guarantee it, for a circle of one hundred miles radius covers just a hundred times as large an area as one of ten miles radius and gives him one hundred times as great likelihood of apparent success *somewhere,* as if the region of his efforts were the smaller district.

A sequel to this appears in later dispatches from Milwaukee, in which Wisconsin farmers are said to offer "Rainmaker" Hatfield $3,000 an inch for producing rain. The item states further that "Hatfield has made rain for the farmers in three counties in Washington State, where he was paid $3,000 an inch. His rainmaking equipment consists of a huge tank 20 feet high in which Hatfield brews a mystic chemical mixture which, he says, opens up the clouds." (*New York Times,* July 27, 1921.) The following summer (1922) found the same operator in Naples in response to appeals from southern Italy, where no rain had fallen for six months and the drought was causing distress. The Press reported him as assuring the sufferers that there would be copious rainfall within two weeks after he got his apparatus in working order. As the whole undertaking quietly dropped out of notice we can only conclude that there was not much encouragement in the results. If the promised "torrents" ever arrived they were far behind schedule time.

There is here the same difficulty in tracing any connection between supposed cause and effect—the same kind of difficulty that is present in the pretensions of the dowser. The operator goes through his performance (so does the Indian medicine-man); somewhere, in some measure, rain falls; and the blunder, as old as man, of confounding *post quod* with *propter quod* continues.

Recently Professor W. D. Bancroft and Mr. L. F. Warren have proposed to disperse fogs by discharging electrified sand upon them from an aeroplane above them. This treatment, it is claimed, will also drive the minute particles of water vapor together and produce drops large enough to fall as rain. Fogs have been thus dispersed but rain has not been produced from a cloudless atmosphere, and it seems contradictory that a mutual repulsion of droplets should result in their coalescence.

The process of passing from aqueous vapor through clouds to rain is not yet well determined and the rainmaker, who must perforce be scientific, is obliged to proceed in a manner that he can show conforms to "theory." Unfortunately the theories mix good and bad science and not one is conclusively established to the exclusion of the others. The rainmaker favors a combination of two: (*a*) that dust nuclei should be in the air, about which water vapor can gather (smoke, either from surface fires or exploded bombs, will meet this need); and (*b*) that jars or concussions will so jostle or disturb the air that the water particles will attach themselves to these nuclei. The process of coalescence begun, it will continue of itself although the exact reasons for so doing are not altogether understood, or at least physicists are not agreed upon them. This, however, is not the rainmaker's concern so long as they do act. Mr. McAdie flouts the concussion idea. He says "Rainmakers of our time bang and thrash the air, hoping to cause rain by concussion. They may well be compared to impatient children hammering on reservoirs in a vain endeavor to make water flow."

That was written in 1895, and scientists have about the same opinion today, but in 1918, nearly a quarter of a century later, a popular old English almanac, *Raphael's Almanac or the prophetic Messenger and Weather Guide,* gives this caution to its readers:

No reliance should be placed on weather predictions during the war, as the terrific bombardments cause violent concussions in the atmosphere, producing clouds and rain, particularly in the southeast and east of England

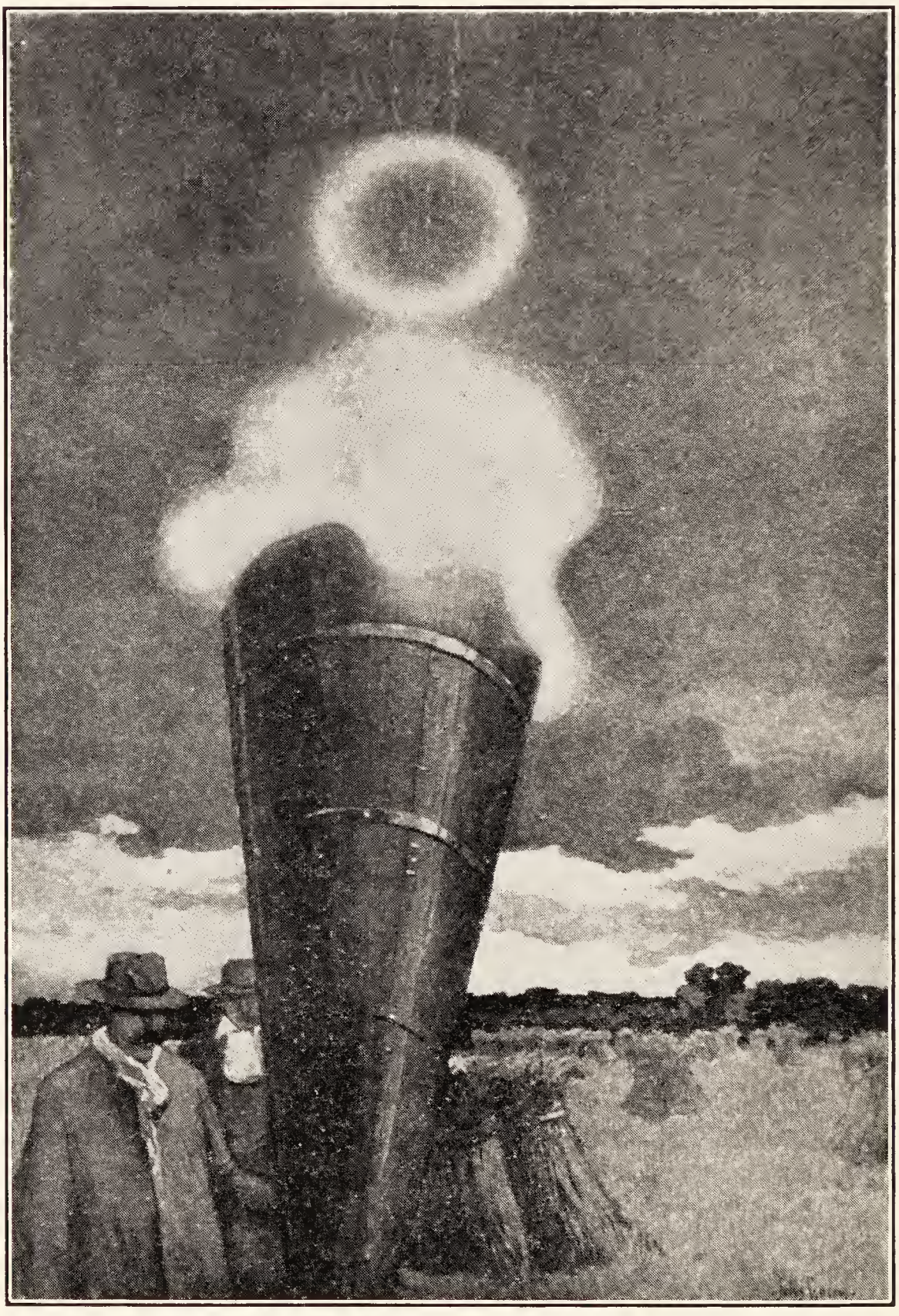
showing how erroneous notions, if popular, persist even after they are quite discredited by good authorities.

Various processes for rain-making have been patented, and the business is carried on with a good deal of financial success by the dowsers of the clouds. They succeed in getting testimonials apparently with little difficulty, in which the witnesses testify to things as of their own knowledge, which occur simultaneously in places twenty miles or more apart, and similar inconsistencies.

The other side of the shield is not without interest. When clouds take on a sinister aspect it behooves man to do what he can to fend off the injury which they threaten. A hailstorm may work havoc, and in a few minutes may wreck all the hopes which the agriculturist has erected upon the labors of an entire season. It means disaster. Especially has this been the case in the rich wine-growing districts of France, Italy and Austria. Hailstorms are not uncommon there, but familiarity does not breed contempt. The growers learn to recognize pretty readily the signs of such storms, which usually cover a small area; and the clouds from which the hail falls are massed in a limited region or pass over a narrow strip of territory.

After various haphazard experiences of viticulturists, one of them, an Austrian, Albert Stiger, invented a form of cannon in 1896 which could be readily and, it was thought, effectively used for the purpose of repelling and breaking up such storms. This cannon somewhat resembled the old bell-mouthed blunderbuss in form, with a chamber at the breach for a cartridge containing only powder, and a funnel-shaped tube like the cone of a megaphone. Housed in little shacks on the hillsides, these were

ready for use at short notice, and since they were distributed among the many adjoining vineyards, a whole battery of



Firing at an Approaching Hail Storm.
(*Courtesy of Everybody's Magazine, and the Artist, Jules Guerin.*)

them could be brought into action promptly. The grapes are maturing and the vineyards are in their most vigorous growth from July to September, when hailstorms might be expected, and the workmen accordingly are alert in watching for signs of danger. When the storm was seen to be gathering, the cannons were brought out and directed against the threatening cloud. Signals were sent from vineyard to vineyard and upon the first appearance of the destructive hailstone the counter bombardment would begin. From the mouth of the cannon issued a mass of heated gas, smoke and smoke rings, propelled violently against the lowering cloud. The smoke rings were like those discharged from the smoke stack by the puffs of a locomotive, but with far greater energy of propulsion. In a sense this was anticipating the war, for it was a veritable gas attack in the realm of the aeronaut. No theory of the action is satisfactory yet sometimes the bombardment has been followed by a dispersal of the clouds, and the threatened storm has not materialized. It is hard, at such times, to convince the relieved grape grower that the cannons have not shot the storm away. It is an old, familiar form of delusion. On the whole, the plan has proved a disappointment, and only helps to fix the status of weather control more assuredly as a "vagary."

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CHARLATANISM

Among the many people who "live by their wits" there is a class who prey upon others subtly yet publicly. Their impelling motives, cupidity and desire for notoriety are stimulated by their vanity, and their rudder is hypocrisy. Although it is their business to live at the expense of others, it is not as parasites or fawning dependents; rather, they make dupes of their patrons, and they do this by pretending to possess knowledge or skill of a high order in some professional line. Their victims become their prey through sheer credulity and the predatory class are *charlatans*. They have flourished ever since men have recognized a distinction between *meum* and *tuum*. Their practices follow almost any direction (we have already described some in other chapters), but they have been most numerous and most flagrant in connection with medicine, posing as specialists, in which capacity they are familiarly and contemptuously termed "quacks." A person who is ill or suffering cannot be blamed for seeking relief, and as a layman is not supposed to understand the mysteries of a healing science, it is hardly fair to condemn him if he is imposed upon by pretenders and listens with a willing ear to words of hope and promises of relief, even if they are groundless; and the treatment by quacks ranges from the use of ridiculous nostrums and rare medicines to the repudiation of all medical remedies.

Noted Charlatans

These have been too many and too varied to recite the careers of any but the exceptional ones. At the head of the procession stands Joseph Balsamo, more commonly known by his assumed title Count Cagliostro;—easily first, a master beside whom others of wide repute were mere tyros,

little better than apprentices; an adventurer of the rankest type, a knave despite the efforts of his admirers to make a hero of him. Equally at home in a street brawl or a court intrigue, a polished courtier and a finished rogue; now in Italy, now in Russia; in Poland next and then in London vainly exerting his wiles on hard-headed Britons, and again back in Paris; setting the whole order of freemasons in a

turmoil, and in turn provoking the anathemas of His Holiness the Pope; pleasing of address, persuasive of speech, skilled to the utmost in black art; while seeming to serve the purposes of diplomats and courtiers in reality making them his dupes, his followers, and obsequious servitors; his was a career of charlatanry such as the world had not seen before, and which has not been equaled since. Francis

Bacon was ambitious when he wrote "I have taken all knowledge for my province," and Cagliostro, with a depth and breadth of understanding coupled with shrewdness and unbounded assurance, might be said to have taken all chicanery for his province, for there was no species of it of which he was not a master—astrology, alchemy, spiritism, mesmerism, miraculous cures, legerdemain—all were tools at his ready command.

His picturesque career has been a theme for romance as well as historical scrutiny. We can give it only in bare outline. His childhood is obscure. He is said to have been born at Palermo in 1743 and at the age of thirteen he was placed in the care of the Father General, in the monastery of the Order of Benfratelli at Cartagirone where he was put under the tutelage of an apothecary from whom he learned the elements of chemistry and medicine. He soon proved incorrigible and was expelled in disgrace. He entered at once upon a career of fraud and adventure; unmasked at one place, he fled to another; falling in with others of his ilk, he traveled as mountebank; studied and practiced astrology and alchemy; he soon amassed a large amount of money and jewels, and traveled in great state with coach and four in Italy, Spain, and Portugal. In 1776 he was at London where he got himself initiated in a masonic lodge but it was not long before he had grown too big for that order, for he posed as Grand Master of the Egyptian Rite, which he maintained was the original masonic practice from which moderns had departed, and as he had mysteriously become the authorized exponent of the true principles of the order he lorded it over all others. Upon some masons he made a profound impression, others repudiated him outright. In March 1779 he was at Mitau in the Baltic provinces, thence to St. Petersburg in the hope of shining at court there, but the Russian capital at its coldest was too hot for him. The autocratic Empress Catherine II had no mind to become

the dupe of an adventurer and ordered him out of the country without ceremony. In May 1780 he was at Warsaw, a prominent figure. There, as elsewhere, he went through a lot of spiritistic flummery but was detected in a fraudulent attempt to convert mercury into silver. In September of 1780 we find him at Strasburg where he was received with great enthusiasm. Here, at that time, resided Cardinal de Rohan who was carried away by Balsamo's achievements and abilities, and was a firm believer in his alchemical powers. From here Balsamo went to Paris in January 1785, where also he was under the special patronage of Cardinal de Rohan and was all the time in close collusion with him. He had married a beautiful, quickwitted Roman girl, whose skill and cleverness helped him through many an embarrassing and difficult situation. In Paris his meteoric career reached its culmination; he presently became involved in the affair of "The Diamond Necklace," which was ultimately to lead to his ruin. This affair which, in distorted form, Dumas employed to express his hostility to the queen Marie Antoinette was in essence as follows:

The court jeweler Böhmer had a magnificent diamond necklace left upon his hands after the death of Louis XV and the exile of Madame du Barry for whom it was intended. Madame de La Motte to some extent gained the favor of Cardinal de Rohan who was Grand Almoner to King Louis XVI and who was deeply enamored of the Queen Marie Antoinette. The queen, on the other hand, had been seriously offended by the cardinal and had become his enemy. Madame La Motte tricked the cardinal into believing that the queen was favorable to him, wanted the necklace, and authorized him to get it for her. The cardinal obtained the necklace and handed it to La Motte to be given to the queen. The diamonds disappeared and the queen was involved in a great scandal in consequence. Madame La Motte was arrested and convicted of theft; she threw the blame

on Cagliostro, charging him with having perpetrated the fraud at a seance. De Rohan was also implicated but both he and Cagliostro were acquitted by the court. The impression always remained, however, that Cagliostro was not wholly guiltless, nor were Rohan's skirts quite clear.

Cagliostro was formally banished from France in 1788 and soon after reappeared at Rome. His masonic pretenses had brought him under the ban of the Holy Inquisition, and on December 27, 1789, he and his wife were arrested and thrown into the prison of the Castle San Angelo. Throughout his trial by the Inquisition he maintained an air of impudent bravado, but he was convicted, and condemned to death as a heretic. Pope Pius VI, on March 21, 1791, commuted the sentence to life imprisonment. He was removed from San Angelo to the castle of San Leon, Urbino, "where," says Mr. Evans, "in a subterranean dungeon, he fretted away his life in silence and darkness until 1795, when he died." (*The Monist,* July, 1903.)

In connection with his masonic pretensions he boasted of his great age. He claimed to have been one of the guests at the marriage feast at Cana, and to have witnessed the crucifixion. His appearance on the scene seventeen centuries later was not a reincarnation, as was held by Nostradamus and other famous predecessors to have occurred in their cases, but he insisted that his existence had been continuous. That he should care to make such claims is rather to be wondered at, for the trait in his character that was most emphasized by his entire career was that *he lived only in the present.* Whether on the crest or in the trough of the wave, he was concerned only with the passing moment; for him, the past had no meaning and the future did not exist. He would make preposterous statements, such as his proposal to light the streets of London by means of sea water, and was oblivious of the fact or indifferent to it, that if he did not substantiate his claims, or as is said colloquially

" make good," he would certainly be discredited and probably ostracized. He was lacking utterly in a sense of responsibility, and after his expulsion by the monks, he spent a large part of his remaining thirty odd years in undergoing imprisonment or in eluding it.

Charlatanism in its various phases is of all times and all peoples; even in connection with the treatment of physical ailments it is infinitely varied, this type being usually characterized as quackery.

An eminent authority upon this subject places at the head of famous quacks and charlatans, Paracelsus (1493–1541). The real name of this celebrated physician was Theophrastus Bombastus von Hohenheim. He was born near Zürich,

Switzerland, and died at Salzburg, Austria. He too, like many another medieval fraud who was as anxious to mystify as to clarify, invoked the Kabbala to support his declarations of astrological influences upon health and character.

" His fame as the greatest of charlatans appears to have been due, in large measure, to his influence over the popular imagination

by the magic power of high-sounding words which were mostly beyond the comprehension of his hearers. . . . He was the first to promulgate the theory of the existence of magnetic properties in the human body. . . . Thus probably originated the idea which developed into Animal Magnetism, and from it Anton Mesmer is said to have derived inspiration some two hundred years later. . . . Paracelsus was a very prince among quacks. . . . He was emphatically a knavish practitioner of medicine, a master of the art of puffery, and was phenomenally successful in achieving the art of notoriety. . . . His system was founded upon mysticism and fanaticism of the grossest kind." *

Nevertheless, a good word is to be said for him, for he was sufficiently in harmony with his time to be acceptable to his contemporaries, and enough in advance of them to be a leader into new fields of knowledge. Dr. Lawrence continues

"Paracelsus was foremost among a group of extraordinary characters, who claimed to be the representatives of science at the close of the Middle Ages. These men were of a bold, inquisitive temper, and with all their faults, they had a noble thirst for knowledge. These irregular practitioners, however impetuous and ill-balanced, were pioneers in opening up new fields of investigation, and in exploring new paths, which facilitated the progress of their successors in the search for scientific truths" : sometimes!

No matter what misdeeds may be charged against such celebrities as are typified by Parcelsus and Cagliostro, their unquestionable abilities, objectionable as the possessors may have sometimes made them, have secured to them a following, and long after they have passed away apologists and admirers continue to plead their cause and extol their virtues. The judgment that is passed upon them is likely to take its tone from the temper of the judge—harsh if he sees only the faults or magnifies them, apologetic if he is sympathetic. The most common fault of judgment seems to lie in a failure to view the characters in the light of their own time, and of the social conditions under which they lived.

* *Primitive Psycho-Therapy and Quackery.* Appendix. Dr. R. M. Lawrence.

Views that to us seem absurd were by no means unreasonable then; practices that with us would be indecent, if not criminal, were tolerated in their day with little objection; while charms and incantations against malign influences, beliefs and omens that to us are rank superstition, natural occurrences that to them were magic—these all, in their time, belonged legitimately in an honest pursuit of science if the practitioner chose to use them in an honest spirit; and the great difficulty has always been to determine where sincerity left off and charlatanry began. Both Cagliostro and Paracelsus have warm advocates and defenders today; and the latter, especially, is the subject of a sympathetic and appreciative biography* that presents him in an amiable and admirable character, misjudged because of the failure of which we have just spoken, to consider him as of his age.

In a most interesting discussion of quackery (p. 322) in the book from which we have just quoted, Dr. Lawrence points out the remarkable psychological features of many "cures." His account of healing by the imagination; of charms, spells, talismans, etc., includes many curious and interesting practices. Especially informing is it to trace *the progress of an idea* from Mesmer with his "magnetic fluid" and his denial and repudiation of cure by imagination or "suggestion," through the various aspects of "animal magnetism" to hypnotism as recognized and practiced today.

Quacks and Quackery

An amazing compilation of American quackery was published by the American Medical Association about ten years ago, consisting of articles reprinted from the *Journal* of the Association during less than ten years previously, and recounting current instances of the practices advertised and their results.† The separate instances were scattered as

* *The Life of Paracelsus.* By Anna M. Stoddart, London, 1911.

† *Nostrums and Quackery.*

to time and locality, and when thus separate were not particularly impressive, but when seen collectively they were not only a startling but a shocking exhibit. They were selected from a larger number of articles in the *Journal,* and included many names of cures and curers that are household words. Under the following headings in the collection there are over fifty in

Part I. Quackery

Advertising Specialists,
Cancer Cures,
Drug Cures,
Consumption Cures,
"Female Weakness" Cures,
Mail Order Medical Concerns,
Mechanical Fakes,
Medical Institutes.

There are nearly ninety in

Part II. Nostrums

Asthma Cures,
Baby-Killers,
Cure-Alls,
Cough Medicines (well-known drops, expectorants, etc.),
Diabetes,
Food Tonics,
Habit-forming Nostrums,
Hair Dyes,
Headache Cures (such as anti-kamnia, shac, etc.),
Kidney Remedies (as Warner's Safe Cure),
Laxatives,
Miscellaneous Nostrums,
Obesity Cures,
Prescription Fakes,
Rheumatism Cures,
Sea Sickness Cures.

There are five in

Part III. Miscellaneous, of which The American College of Mechano-Therapy is a striking example of manipulative cure without knife or drugs.

Many of the separate "cures" contain several distinct remedies so that the actual number is much greater than the list indicates. The audacity, the actual impudence, of many of these fakers is thrilling. They do not hesitate to guarantee a cure; they announce "No pay until cured"; and the "Institutes" boast of the extraordinary medical skill and training of their doctors, as fully attested by their diplomas from renowned foreign Institutions. Says Dudley F. Sicher in an address before the Biological Club of Yale, "How the charlatan manages never to lose out would make a realistic novel in itself. Suffice it to indicate his crafty reliance on creating 'the habit'; one bottle with its high content of alcohol will inevitably 'tone you up,' or admixed opiates may be the 'irresistible pain-killer' to which you will want to turn again. . . . Psycho-therapeutics and knowledge of human nature constitute the quack's entire outfit; all he really needs is moral atrophy and the instincts of a cheap drummer." * Certain it is that quacks are and always have been past-masters in the art of advertising, and the tricks which they use are so flagrant and so discreditable that legitimate practitioners, in sheer defence of their self respect, were compelled to abstain from advertising at all, so that the mere fact of resorting to this mode of publicity came to be sufficient proof of quackery in the advertiser, and a reliable criterion of his real status. The advertisements are sly as well as audacious. One trick in them that still persists is to proclaim a simple remedy for some common but troublesome ailment—gout, rheumatism, or the like: "send no money, a postage stamp will bring prescription"; it arrives in due time with advice on sundry

* *Popular Science Monthly,* for 1905.

The Mountebank.

From the painting by Pieter Van Laer in the Royal Picture Gallery of Cassel.

points, including the information that "If your druggist has not all these ingredients we will be glad to make up the deficiency upon your remittance of ..... dollars"—and there is always at least one article that is unknown to the local druggist!

Consultation of Physicans.

In an illuminating article on "Medicine Fakes and Fakers of All Ages," Dr. John A. Foote tells us that nostrums,

cure-alls, and quackery are lost in the dimness of extreme antiquity. In picturesque fashion he recounts instances of quackery in ancient Babylon and Rome, and says that Hiera-Picra (chiefly aloes) was sold as a panacea in Damascus a thousand years ago.*

During the seventeenth and eighteenth centuries England was fairly overrun with quacks. Springing from the meanest origins, they came not infrequently into royal patronage, and practiced with the most brazen impudence. Their preparations were secret but when analyzed usually proved sheer frauds. In those days they traveled the country over in great state, proclaimed their nostrums from a platform, on which they would give public treatment, and worked tricks of advertising of every conceivable sort. In their desire for notoriety not all are so successful as several once famous English quacks whose portraits have been secured to posterity by the skill of no less a master than Hogarth. His *Consultation of Physicians* or, as it is also known, *The Undertakers' Arms,* depicts a gathering of quacks in consultation, and as the outcome of their practice can hardly fail to provide business for the undertakers, it is fitly drawn as a coat of arms for that guild. The superior and most conspicuous figures of the company are three at the top of the shield, good likenesses of Dr. Ward at the right (of the person viewing the picture), Mrs. Mapp in the middle, and Dr. Taylor at the left. Mrs. Mapp (died 1737) was known as "the bonesetter," and here carries a bone, apparently a femur, as her insignia. She acquired large wealth but died in poverty. Dr. Ward (died 1761) was a footman, became famous for his "Friars' Balsam," and received the royal patronage of King George II for whom he was called in to prescribe. Dr. Taylor (died 1767) called himself "Opthalminator, Pontificial, Imperial

* *National Geographic Magazine,* January 1919.

and Royal"; he carries in his hand a cane with an eye in the head of it. A little earlier than these was Sir William Reed (died 1715), a tailor who was knighted by Queen Anne, and was employed by both Queen Anne and King George I. He was especially strong in the cure of wens, wry-necks and hare-lips.

The nineteenth century was not lacking in rivals to these pretenders. "Beecham's magic cough pills," found to consist of digitalis, white oxide of antimony, and licorice, were the production of one Bechic (not Beecham). Professor Holloway dispensed a celebrated ointment and famous digestive pills; the former was made of butter, lard, wax, and Venice turpentine and the latter of aloes, jalap, ginger and myrrh. He spent immense sums in advertising. Dr. Morrison was another who was famous for his pills, which consisted of aloes and cream of tartar in equal parts. It is said that Professor Holloway, Dr. Morrison, and Rowland, a maker of hair oil and tooth powder, were the greatest advertisers of their generation.

As we have just pointed out, the twentieth century fully keeps up the pace of the earlier periods. The brass band has given place to the printing press but the mountebank is not yet extinct. Not only at street corners of populous cities do we encounter the hawker or vendor, surrounded by a shifting clump of people craning their necks to see and hear him as he extols the virtues of his wares. In small country towns the mountebank takes his stand upon a raised table or platform in the public square, lights a torch, unslings a banjo, and soon gathers around him a number of curiosity seekers. Intermitting his songs and jokes with palaver about his wonderful remedy, if his auditors seem to tire of that he catches their interest again probably by sleight-of-hand tricks, sword swallowing or the like, and passes out bottle after bottle of his wonderful elixir. Such scenes are within

the recollection of the author and, no doubt, of others who are younger.

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RADIATION

We have seen that for mechanical effect nothing was so potent as "vibration." This was the trump card of the Keely Motor; but as occupying a higher plane, and at the same time offering a wider field for exploiting occultism, "radiation" has been even more attractive.

The Blue Glass Mania

Between 1870 and 1880 large portions of America and Europe were inundated by a wave of enthusiasm that became known as "the blue glass craze." The necessity of sunshine for healthy growth both of animals and vegetables had long been known. The fact was also recognized that the light of different parts of the spectrum was not only due to difference in the physical action producing the light, but that different degrees of stimulus resulted from the different kinds of light, the red and infra-red being intimately associated with heat, the yellow with illumination, and the violet and ultra-violet with actinic or chemical effects.

Biology was now coming into prominence as a special field of science, and cell-growth and the making of animal tissue, whether bone or muscle, were studied industriously. Bacteria and the whole germ theory of disease were demanding the attention of students of medicine. It soon became known that not only did light foster some kinds of growth, but it hindered or prevented other kinds; was favorable to some germs and destructive to others; but more than that, these different results could be connected closely with differently colored lights, and perhaps it was just the difference in color that made the difference in result.

The idea that blue and violet rays were especially healthful in certain ailments had taken hold upon many, and it

was not long before theory included the red rays to treat other forms of disorder. As early as 1861 General A. J. Pleasonton began experimenting on the use of blue rays in a grapery, which was covered and encased by sashes of glass of which every eighth row of panes was, as he supposed, violet in color; at least they appeared so to the eye. The vigor, the health, the productiveness of the vines was astonishing, not only to himself but to all who saw them. For eight years this wonderful growth was continued; then, in 1869, he began to try the effect of the colored light on the growth of animals. One litter of pigs he placed in an ordinary pen, and another in a beautiful glass house with a proportion of violet panes, in the light of which the little rooters bathed luxuriously and gleefully. A few months were enough to show that those under the violet glass were rapidly outstripping their less favored companions.

In 1871 General Pleasonton read a detailed paper on his theory and experiments before the Philadelphia Society for Promoting Agriculture, which was published, had a wide circulation, and attracted much attention. An edition appearing in 1877 was printed on blue paper. In the preface to this he says

"... I fancied that the glass itself was of a violet tint, and so attributed the remarkable results within the grapery to violet rays. ... I investigated the matter, and found that the glass was a dark mazarine blue,—owing its color to a preparation of cobalt which had been fused with the material composing the glass. ... Whatever effect may be produced by the use of violet colored glass is to be attributed to the proportion of the blue ray which enters into the composition of the violet ray of light, and not to those composite rays themselves." *

To mistake dark blue glass for violet was not extraordinary since this glass did look violet by reflected light.

General Pleasonton's ideas were eagerly taken up and rapidly disseminated. A wealthy Baltimorean who suf-

* *Blue and Sun-Lights, Their Influence upon Life, Disease, etc.*

fered from chronic rheumatism was to be seen on sunny days, driving in a phaeton of which the cover was a canopy of blue glass, while at home his luxurious study was flooded with sunlight filtered through glass of this same vivifying color. About this same time Dr. Seth Pancoast of Philadelphia published a work, printed on white paper, in blue letters, with a red line border, entitled *Blue and Red Light; or Light and Its Rays as Medicine.* The purpose of the book, as the author states it, was "not only to prove that the gentle Blue ray has curative properties for some disorders, and the strong, Red ray for others, but to demonstrate just why they, and not the Green or the Yellow, must be employed, and how they act, and then to explain the best methods of employing them." *

It seems in place just here to notice that the advocates of obscure or bizarre doctrines make much of tenets and practices that are or claim to be very ancient; and of those early sources none is more influential than the *Kabbala.* The Rosicrucians are darkly mysterious, but incomparably wise with the lore of this ancient mystical jumble. The potency of light in its separate components Dr. Pancoast finds fully expounded in this compendium of ancient mysticism, according to which everything, good or bad, wise or foolish, has its source in gods, devils, or the stars. The uninitiated can never realize the profundity of its secrets, but he who knows the *Kabbala* has the key to all the enigmas of nature that perplex the modern philosopher, so great is the power inherent in antiquity.

To find modern knowledge or discoveries foreshadowed in *ancient clouds* requires an interpreter who is quite ready to discern what he is looking for, something like the Baconian authorship of Shakespeare. Such vision is of the same order as the conviction that the early Egyptians must have possessed mechanical powers unknown to us, to transport

* *Kabbala,* p. 53, Harvard Edition, Worthington Co.

and raise the ponderous blocks of stone, and erect the massive structures of the pyramids; that they must have had greater knowledge of astronomy and physics than we give them credit for, to orient their buildings with accuracy; and that our own power today would be larger and our welfare greatly enhanced if we but possessed their wisdom. In this spirit of interpretation, Dr. Pancoast found in the *Kabbala* a wonderful revelation of the curative powers of light.

X-Rays, Radioactivity, Radio-Therapy

The mere facts of sunburn and tanning were enough to show that the bare skin and possibly deeper tissues are affected by sunshine. When it became known that sunlight is not single but consists of rays differing in refrangibility, a study of the effect of the rays separately was inevitable. Every additional discovery of rays beyond the visible spectrum revealed new powers of the rays as features of physics and chemistry, and stimulated inquiry into their physiological action. As the science of bacteriology grew, its application in medicine produced innumerable serums, cultures, and antitoxins, which raised hopes of mastering diseases that had baffled physicians—hopes that were fulfilled to an amazing degree—although the new practice opened new pathways to quacks; and as different orders of radiation became known, the vista of wonders to result from their action lengthened and deepened. In connection with radiation and its phenomena popular notions—vagaries as well as sound ideas—have turned most promptly to medical applications. Light-Therapy and Radio-Therapy are now recognized as distinct fields of medical practice and research. The discovery of X-rays was followed by wild views and fantastic theories of science, but the application of this new agent has been more especially successful and serviceable in surgery.

The enthusiasm with which any such new means of healing is hailed leads to extravagant predictions which are often disappointments, and sometimes are followed by actual reversals. The truth is brought out by scientific investigation, and whatever is good and true in the discovery survives while the mistaken ideas concerning it are abandoned, but until the error is so completely proved and its harmfulness is so clearly established that further persistence in it is criminal, the charlatan will trade upon it. Thus not only electricity but radium is exploited. After there was indisputable evidence of the destructive action of this new element upon certain kinds of tissue, and high hopes of benefit from it in the treatment of cancer had been raised, comes the adverse report that sometimes radium actually furthers the progress of the disease.

In general terms, the experiments up to this time seem to indicate that radiation of the shorter orders, i.e., violet and ultra-violet rays and the still more rapid radiation of X-rays and radium, are destructive to many forms of bacteria and *irritating* to healthy tissue; and that supposed beneficent action of lower orders of radiation, the red and infra-red of the spectrum, is merely a *negative* effect. Healing may ensue under them because the affected tissue is free from the irritation that would be caused by the blue, or violet, or ultra-violet portions of white light. The healing effect of these latter rays results from their destruction of the disease germs, or an increased flow of healthy serum. Evidently, in this view, the advantages of radio treatment have to be balanced against its possible dangers. Considerations like that, however, are not usually deterrent to a charlatan. Along the border of legitimate usage is ever a fringe of questionable practices, with pretensions based upon ill-digested experimentation. A Viennese professor reports as a result of his use of X-rays in treating women

between forty and fifty years of age, "In some cases my Roentgen treatment caused a complete change of appearance. Fresh complexions returned, wrinkles disappeared, and the patients recovered the buoyancy of earlier life." (*New York Times,* Feb. 1, 1921.) If that idea, whether correct or not, once takes hold of certain classes of society, we may expect to find an X-ray outfit among the accessories of the beauty parlor.

What the various rays cannot do has yet to be learned —and until their limits are assuredly known their supposed capabilities will go on soaring. Their germicidal action affords a great opportunity for quacks. If one would see the absurd uses they make of it, let him visit the baths of Bath, England (probably those of any other spa would do as well), place himself under the guidance of the vain, pompous and officious attendant, and keep a straight face if he can while this worthy vaunts the merits of the electric baths, and explains the nature of their beneficial action; tells you exactly the path the electric current takes; descants upon the marvelous effectiveness of the radioactive waters; and goes on with a farrago that probably does impress many a patient; surely, the visitor thinks, the fountain of youth is here; let him listen, but should his gaze wander to the enfeebled form of the shuffling, decrepit guide, he will certainly be reminded of the shoeless cobbler, the tailor in tatters, or the baldheaded barber who has an infallible hair restorer.

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OTHER ANCIENT FOIBLES

Human Flying

The vagaries that have excited popular interest are too many for us to enumerate them, much more to present them with any completeness, but several others of more than ephemeral character ought to be considered here. In some cases the end sought has really been attained, though in a different form from that which was at first expected, and by a great modification of the path originally marked out, owing to increased knowledge of principles and improved methods of operation. Notably is this the case with aviation. All early efforts to accomplish this were directed to the achievement of flying as exhibited by birds, with flapping wings. Doubtless genuine attempts at mechanical flight by means of wings have been made, but descriptions and illustrations are principally those merely of ideas or plans conceived by some inventor—plans which, like devices for perpetual motion, have failed to reach the stage of a working model. Mechanical flight figures in mythology—the idea is as old as the ages—and ingenious writers have given their imagination free rein in depicting achievements of this nature and the machines by which they wrought their astonishing performances. The story of Darius Green and His Flying Machine has been a standard piece of humorous poetry in American literature for many years, and thrilling encounters in the late war give point to the accompanying illustration from an old work.

After futile attempts to fly in this manner came the balloon, in 1783, and floating or drifting in the lighter-than-air machine was a substitute for flying but not an accomplishment of it. The air-bird gave place to the air-ship, and aviation became aëronautics. The beginning of the twentieth

century ushered in a new era in this art. With the effective propeller and the light and powerful internal combustion engine, the aëroplane became not only a possibility but a magnificent success—but it does not fly. Its problem is one of stability with rigid wings, and it *glides* or *soars*—that is its nearest approach to the flight of birds. It is only quasi-flying, but if this is inferior to real flight in some respects, its inferiority may be compensated in part at least by some advantages of its own.

To skip rapidly from the winged birds through the era of the balloon to the aëroplane gives no idea of the tortuous and difficult path by which the last was reached. The labyrinth of Daedalus, from which he could escape only by means of the wings which he contrived, was not more intricate than the lines of invention and scientific discovery that have led to the aëroplane of today; and no chapter of science records more of perseverance, of inventive power, of hopes and disappointments, or of personal daring, than the history of aërostation. The success already attained has put an end to the derision that formerly greeted the aspirant to dominion over the air, as well as land and water, for his locomotion.

The Universal Solvent

This was another of the elusive objects sought by the alchemists. It is not easy to decide just how far they meant to be taken seriously in connection with it. The idea might have been of service to them in exciting the fear of the superstitious, for such an article would certainly have alarming powers, but the alchemists themselves were too astute not to realize the fact that if they succeeded in producing a universal solvent there would be nothing in the world to keep it in. There can be no doubt that many of these canny old philosophers belonged in the same class with the Roman augurs who could not look one another in the

face without laughing. When the philosopher's stone lost its glamor this chimera, too, ceased to be attractive.

The Elixir Vitae

Because of its more continuing human interest, the elixir of life was more persistent in its allurement than the universal solvent. Itself a product of alchemy, and something to be made in the laboratory, its pursuit was restricted to the votaries of chemical science; nowadays, from the similarity in purpose and also in the idea underlying each, the elixir of life and the fountain of youth are often spoken of together, as if they were interchangeable and had always been thus associated, but historically they are independent of each other. It was thought that by the use of the philosopher's stone or by processes like those by which this was produced, a liquid might be obtained that would indefinitely prolong the life of him who quaffed it. More, if he were young his youth would be perpetuated; if old, he would be rejuvenated; and when a belief in such a product prevailed, the aged alchemist would have been more than human if his decrepit figure, his failing mental powers, and palsied limbs were not invigorated as he inspected the brew that was charged with the hope of a youth renewed.

As gold was the most noble of metals, presumably the elixir would take the form of some preparation of gold; and the dream has persisted to the point of modern use of a gold compound as a destroyer of the taste for alcohol, and a cure for drunkenness.

Efforts at rejuvenation are merely one phase of the healing art, and naturally passed from the alchemists to the biologists. On the theory that the secretions from certain glands in the body contribute especially to the functions of organs of vitality and reproduction, the late Dr. Brown Sequard, who had won honorable distinction in medical practice, acquired a less desirable notoriety by his proposal

in 1889 to use such glands of monkeys and of sheep to vitalize old men. Every semblance of a success of that kind is startling; the biologist has taken up the cause and is still working along the lines of Dr. Brown Séquard. An important modification of his method was to transplant active sex glands from one animal to another and, succeeding in this, from animals to human beings whose vitality was waning. This was accomplished by Dr. G. F. Lydston of Chicago as early as 1914. (See *N. Y. Times Book Review,* Nov. 7, 1920.) In 1917 Dr. Serge Voronoff of Paris took up the same line of experimentation, and in 1919 announced wonderful success with it. His experiments, however, seem to have been limited to animals, except in the case of one human being, and that had been too recent to furnish any conclusive evidence from its results. As in the problem of aviation, so here, the nature of the *elixir vitae* and the method of attaining it have been radically changed with the advancement of science, while the purpose of the pursuit remains essentially unaltered. Whether the latest conception shall be of permanent value or shall prove to be only an exaggerated and distorted estimate of a hopeful theory, the future alone can determine, but of this we may be sure: this "folly" is one that will not die so long as human beings continue to do so, and as only their ceasing to do so would disprove the folly, its immortality is assured.

The Fountain of Youth

The search for the fountain of youth was impelling like the quest for El Dorado and, if more romantic than that in conception, was hardly less sordid in purpose or execution. The one character that illuminates the theme is Juan Ponce de Leon, and the spirit of the search is concentrated in his expedition to find the island of Bimini. But no mass of prosaic details can obscure the radiance that envelops

the idea and makes it fascinating. With any renewal of activity on the part of one whose efforts had seemed to slacken, or whose energy had apparently diminished, the performer is heartily congratulated on having discovered this life-renewing fountain. With Ponce de Leon, however, it was no phantasy that he sought, but a real pool of real water. Where or how the idea originated is not known; it came home to him as a reality in the story told by an old West Indian woman in Porto Rico, whither she had been brought from a more northern island. De Leon, ambitious and indefatigable, had braved dangers and undergone hardships undaunted and now lay, fever stricken, eating his heart out with impatience, envy, restlessness, and the fear that he might die with his hopes unrealized. He was soothed by the faithful old nurse who quieted his delirium by pictures of beings bright with perennial youth—a blessing which he, too, might gain. She related the story of this fountain in lands still further north, and as her husband and others had long ago sailed north and never returned she was sure they had found it and remained in its country, Bimini. Ponce de Leon's imagination was fired by the picture thus presented to him, but none the less he was a hard-headed explorer intent upon discovering more lands in emulation of Christopher Columbus, and it was primarily with that idea that he set sail in 1512 from Porto Rico (then *Borriqueen*).

He discovered Florida, which he thought to be an island, and within it or as part of it he did expect to find "Bimini" and the wonderful fountain. In St. Augustine is a well which legend declares to be the actual fountain that he was seeking. Among springs of water that is unpalatable if not unwholesome, its water is exceptionally sweet and agreeable and is eagerly quaffed by the many visitors to this old city of the Spanish settlers. De Leon's journeyings, like those of De Soto, Cortez, and all the conquistadores of those

days, were stained by cruelties practiced upon the natives of the strange countries, and only an exaggerated sense of romance on account of a glittering goal keeps the deeds of these conquerors in the background and magnifies the pathos of their failure or tragic death. The sentimental features of Ponce de Leon's voyagings are interwoven with the practical by Heine, with his inimitable blending of wit, humor, and pathos in his poem, Bimini: a tale of hope and cheer which the poet wrote from his invalid's couch after he himself had passed beyond hope of recovery.

APPENDIXES

I

The following letter of recommendation, taken from the advertising circular of one of the leading astrologers of America, will show the importance of choosing the right practitioner in astrology as in medicine. In neither can the doctor be expected to be infallible, but the chances ought to be in favor of the astrologer as he has a more perfect scheme to guide him. It also serves to show the difficulty of distinguishing the genuine artist from the charlatan. The original is not italicized.

".....Boston, Mass.

Dear .....

I have been for the past thirty years or more a believer in Astrology, but it has been by you most clearly presented to me. In every instance *your predictions have been diametrically opposed to other Astrologers* I have visited, except the late St. Leon.

The predictions *made by you* to me during the past five years have in almost every instance been verified.

It gives me great pleasure thus to acknowledge your superiority in your profession.

Yours truly, ..."

Swift could hardly have done better!

II

Concerning the Runic Characters on the Clog Almanac Described on Pages 49–53

Practically all printed accounts of this ingenious calendar since 1686 are drawn from Dr. Plot's Natural History of Staffordshire, published in that year. *The Transactions,* Vol. I, of the *Leicestershire Architectural and Archæological Society,* contains a paper by Rev. J. M. Gresley on "The Staffordshire Clog Almanac" in which, after mentioning

various characteristics of this type of almanacs, he quotes from Dr. Plot regarding the figures inscribed upon them: "All follow the Julian form. There are three months contained upon every of the four edges. The number of days in them are represented by the notches, that which begins each month having a patulous stroke turned up from it, every seventh notch being also of a larger size, which stands for Sunday, or perhaps for A, or any other letters as they may come in their turn to be either dominical or week day letters. Over against many of the notches which stand in the clog for the days of each month, there are placed on the left hand several marks or symbols denoting the golden number, or cycle of the moon, which number, if under 5 is represented by so many points; but if 5, a line is drawn from the notch or day to which it belongs, with a hook turned back against the course of the line; that, if cut off at the distance may be taken for a V, which being the fifth vowel, antiquity perhaps has been pleased to make use of to represent the number 5, as X for ten, which is nothing else but a composition of two Vs turned tail to tail. If the golden number be above 5 and under 10, it is then marked out to us by the hooked line, which is 5 with one point which makes 6, or two which makes 7, or three for 8, or four for 9; the said line being crossed with a stroak patulous (broad) at each end, which represents an X when the golden number for the day is 10; points being added (as above over the hook for 5), till the number rises to 15, when a hook is placed again at the end of the line above the X, to show us that number. Above these the points are added again till the number amounts to 19, where the line issuing from the day is cross't with two patulous stroaks (as if it were 20), as may be seen on the clogg, January 5." Regarding the symbols at the right of the notches, of which we have given some account on pages 51–53, Mr. Gresley notes that these markings are

not alike on all the clogs, some of which are sparing of emblems; his specimen has merely lines out from the notches in many instances, and some have other variations, the Norwegian and Danish differing from the English.

Brady's *Clavis Calendaria and Analysis,* Vol. I, pp. 45, 46, gives further quotation from Dr. Plot: "And these numbers are not set so wildly and confusedly against the days of the month, as at first sight may appear, but in a method and order, whether you consider them as they immediately precede and follow one another, or the distance interceding each figure, or the value, or denomination; for every following number is made by adding 8 to the preceding, and every preceding one, by adding 11 to the following one; still casting away 19, the whole cycle, when the addition shall exceed it. Thus to 3, which stands against Jan. 1, add 8, it makes 11, which stands against the third day of the month; to which add 8 again, and it makes 19; whence 8 itself comes to be the following figure, and 16 the next; on the contrary, if to 16 you add 11, it makes 27, whence deducting 19, there remains 8, the number above it and so on, ... *Note:* 3 stands against the 1st of January, because 3 was the golden number when the fathers of the Nicene council settled the time for the observation of Easter."

(To determine the golden number for any year, add 1 to the date of the year, divide by 19, the quotient is the number of cycles elapsed, and the remainder is the Golden Number. See Enc. Brit., Art. "Calendar." The Nicene Council met in 325; adding 1 to 325 and dividing by 19 gives 17 cycles elapsed with 3 as remainder; therefore for the year 325 the G. N. is 3. D. W. H.) Mr. Brady thinks (*Clavis Calendaria,* pp. 47, 48) that these Runic staves of the Anglo Saxons were but "humble imitations of the Egyptian obelisks, which were the *first* species of *almanacs* ever used."

III

Prizes

Innumerable prizes have been established for scientific investigation and discovery. They are offered by Governments, Societies, Academies, Universities, and private individuals. They take the form of medals, certificates, badges and other tokens, and cash. Of the last kind, the largest are those offered by the will of the late Swedish engineer, Alfred Nobel, who bequeathed money for five prizes to be given annually, three of which are distinctly scientific in character.

Sometimes prizes of an opposite purpose are offered, of which we mention a few examples.

In 1901, and frequently thereafter, Mr. Joseph Battell of Middlebury, Vt., offered a prize of two thousand dollars to the first person who could prove the undulatory theories (of sound, light, etc.) to be true, and the offer was made permanent by insertion in *The New Physics,* 1909; and in a letter, 1909, to the *Scientific American,* he says: "In addition, we will give the Secretary of the *Scientific American,* who writes us, five hundred dollars cash if he can prove that our explanation (of the action of sound in a telephone) is not true."

In the *Middlebury Register* of April 22, 1910, he says: "We are disposed . . . to offer another and quite different prize of one thousand dollars cash to the first College or High School of established character, which shall adopt the corpuscular theories of Light and Sound, one of them as expounded by Sir Isaac Newton and accepted for one hundred years by all scientists, and then most foolishly given up; and the other now fully demonstrated and accepted by many if not all of the ablest physicists of the world."

In a communication to the Aeronautical Society of New York City, in April 1914, Mr. Robert Stevenson states

that he had offered "a thousand dollars, through the Editor of *Science*, to the first Scientist who would prove either experimentally or mathematically that bodies did actually fall with acceleration in themselves, as Galileo and Newton believed they did," but does not mention the date of his offer. If the Society would acknowledge the accuracy of his paper, he could secure a very large price for the proving of his theory to be wrong.

IV

Copy of letter severely criticizing the author for his ridicule of the divining rod:

LAW OFFICES
OF
.....

....., MAINE,
October 20, 1913.

DEAR SIR:

I notice an article in today's Bangor Daily News, wherein you are quoted as saying that the "divining rod" is all "rot" and that you had never seen a successful location of water with a rod &c.

Now, I do not attempt to tell the cause, but I have seen many successful attempts to locate water with the rod. I do not believe in the psychology suggested by Pro. Woodworth, for the rod does more than bend down, it actually turns in spite of the person holding it. I, myself, when a mere boy have had the rod turn in my hands, and twist so much that the bark would cleave from the wood in that part held in my hands. I could feel the rod pull down and the tighter I clasped it the harder it would seem to pull. The trouble with you "Scientific" men is that you absolutely refuse to give any weight to anything that might indicate that there is something to man beside mere matter. I suppose you also deny, that the table will tip or turn, when several persons lay their hands lightly upon it and keep them there for a while, yet, to my own personal knowledge, this is true. My brother and I used to practice it when boys. I do not suppose you believe in independent clairvoince, but I do, for I have had at least three hipnotic subjects who told me the time by my watch, after I had close it in my hand, and turned the hands around so no person knew how

they pointed. There can be no effect without some cause,—why not take into consideration the fact that the Almighty might have created a force that is still undiscovered? That all the laws of nature cannot be known yet to man, and that in the last analysis, really nothing is nown? What is electricity? life? mind? soul? Is there any future existence beyond the grave? Yes, what is water, salt, heat, wind, minerals? When a man gets so wise that any statement of a reasonably honest man regarding a phenomenon is called "rot," he is butt wone degree remove from a fool?

Along the line of spiritualism, clairvoince, telepathy, &c., there have been some honest as well as learned men, enough so that any man who dogmatically repudiates the phenomena without duly investigating, shows his disqualification as a scientist. There is nothing too wonderful to be true and nothing impossible. With the phenomena so often repeated and so widely diffused, it is mere foolishness for any man who never saw the phenomenon to declair it "rot." When a stick is held tightly in the hands and the bark is *twisted* off, there is some cause for it, and I know by observation that water is often located by this means. These things cannot be known to be false unless investigated. One true phenomenon is worth more than all the world's unbelief.

Yours very truly,

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